THURSDAY, JULY 25, 1889.

COMMERCIAL ORGANIC ANALYSIS.

Commercial Organic Analysis. A Treatise on the Properties, Proximate Analytical Examination, and Modes of Assaying, the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c.; with Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By Alfred H. Allen, F.I.C., F.C.S. Second Edition, revised and enlarged. Volume III., Part I. (London: J. and A. Churchill, 1889.)

IN this instalment of the amplified edition of Mr. Allen's well-known and valuable work of reference, the substances dealt with are the acid derivatives of phenols, also including aromatic acids and tannins, dyes, and colouring matters; the large additions made to the first edition necessitating the division of the concluding volume into two parts, of which this is the first, the discussion of organic bases, cyanogen compounds, and albuminoids, &c., is reserved for the second part. In consequence, the large majority of the present portion is entirely new, only comparatively short sections on picric acid and basic aniline derivatives having appeared in the first edition, in place of some 270 pages relating to dye-stuffs. Where references to English translations or abstracts of foreign papers are obtainable, the author has deliberately given them in preference to references to the original memoirs appearing in German and other foreign periodicals, on the ground that these publications "are practically, if not absolutely, inaccessible to the great majority of English readers." No doubt so doing saves a considerable amount of trouble to the reader in the first instance; but, on the other hand, concise abstracts such as are to be found in the Journals of the Chemical Society and the Society of Chemical Industry, NATURE, the *Chemical News*, the *Pharmaceutical Journal*, &c., are frequently of necessity shorn of many details of especial importance to the commercial analyst; whilst most chemists concerned in the analysis of dye-stuffs and analogous organic products probably possess in their own libraries the leading German and other periodicals, or at least have access to them in the various public libraries in the manufacturing towns and cities.

Amongst the phenol and aromatic derivatives Fahlberg's *saccharine* (benzoyl sulphonic imide) finds a place; this is stated by the author to be "quite uninjurious, even when taken in considerable quantities," passing unchanged through the system, so that it can be detected in the urine. It would seem, however, that the alleged freedom from noxious effect is a matter still somewhat in dispute, at any rate as regards habitual use; the difference of opinion on the subject being one reason why the Commissioners under the Customs and Inland Revenue Act of 1888 exercised their discretion in prohibiting the use of saccharine in beer (May 1888) until further notice. For similar reasons, the addition of salicylic acid to wine is forbidden in France and other countries, although only one part in 10,000 is essential even as a maximum for the preservation of the liquid; magenta being also prohibited as a tinting material for sweetmeats, wines, &c., on account of the frequent presence of arsenic therein. The use of picric acid as a bitter for beers or "hop substitute" is rightly condemned by the author, on account of the distinct poisonous properties of the substance, rabbits and dogs being killed by doses of from 0·06 to 0·60 gramme (nearly one to ten grains); similarly the employment of dinitro-cresol and naphthalene yellow as "saffron surrogates" for tinting butter, cheese, maccaroni, &c., is strongly objected to on the same ground. In all these and many other instances the various methods of detection of the objectionable substances are carefully detailed, the book being largely intended for the use of the public analyst in connection with articles of food and drugs, as well as for chemists and specialists working in other directions. One of the tests for salicylic acid in beer, recommended on the authority of Blas, is of a somewhat heroic character, and is hardly likely to be adopted by toxicologists as a process of general application: the analyst is required to *drink the beer*, and, after three hours, to examine his urine, the colour-reaction with ferric chloride being stated to be then seven times as delicate as with the original beer. Probably it is the adoption of analytical methods of this description that has led to the popular belief that an analytical certificate of having examined edibles "chemically, physiologically, and dietetically, without finding anything injurious to health in them," simply implies that the operator has lunched on the materials, and has not noticed any particular inconvenience resulting therefrom. In cases where injurious substances are believed to be present, it might be preferable to make the vendor of the suspected goods the medium for the application of the test, thus to some extent returning to the mediæval practice of punishing sellers of adulterated wine by compelling them to swallow a gallon or two of the liquor, and pouring the remainder of their stock over them as an external application of a sobering nature.

In the same section, the general chemistry of the tannins is discussed, so far as it is at present understood, and the various processes described for the valuation of the numerous tannin-yielding materials occurring in commerce. From the tanner's point of view, these are divisible into two great classes, viz. those which produce a "bloom," or fawn-coloured deposit on leather (such as gall-nuts, divi-divi, sumach, valonia, and oak-bark), and those which do not (such as catechu, hemlock, larch, and mimosa); broadly speaking, these two classes yield, with ferric acetate, somewhat different colorations, the first set producing a blue-black, and the second a green, the difference being mainly due to the presence of gallic acid and protocatechuic acid, or derivatives thereof, in the two classes respectively. Curiously, the author has omitted to give, in this connection, any directions for the testing of manufactured *leather*, the adulteration of which with sulphate of barium (mechanically forced in whilst moist and soft), glucose, and analogous weighting substances, has of late years come somewhat prominently into notice, and indeed occasioned special Government inquiry. In connection with tannin, some interesting facts are recorded concerning the examination of documents in cases of suspected forgery or alteration where ordinary ink has been used, more recent writing being frequently

capable of detection by the use of chemicals carefully painted on (such as dilute hydrochloric or oxalic acid solution), on account of its fading out sooner under the treatment. Stephen's blue-black ink is described as composed of 15 parts galls, 5 ferrous sulphate, 4 iron filings, 200 water, and ½ indigo, in 3 of sulphuric acid, no gum, or other thickening being mentioned, whilst other inks usually contain a few per cents. of such substances, copying-inks chiefly differing in containing sugar or glycerine in addition. Sulphate of copper is stated to be added occasionally to inks "with questionable advantage"; the opinions of the vendors and users of steel pens on this point being doubtless dissimilar.

The major half of the book consists of a terse description of the general processes of manufacture, characteristics, and modes of examination of dye-stuffs, classified under the headings of nitro colouring matters, nitroso colouring matters, aurin and its allies, phthaleïns, azo colouring matters, rosaniline and its allies, safranines and indophenols, colouring matters from anthracene, sulphuretted and unclassified coal-tar dyes, and colouring matters of natural origin. On reading the systematic names of many of the artificial dye-stuffs, one can hardly wonder that practical dyers prefer to employ shorter and more colloquial terms, even though these lack somewhat in scientific precision: "xylidene-scarlet," for example, although not absolutely euphonious, is still a much more pronounceable word than sodium xylene-azo-beta-naphthol-alpha-disulphonate; whilst "night blue" is far less mouth-filling than hydrochloride of tetra-methyl-tolyl-tri-amido-alpha-naphthyl-diphenyl carbinol! It is, however, to be regretted when new dye-stuffs are designated by names already well known in connection with substances of wholly different chemical character: thus *narceine* is ordinarily understood to refer to one of the alkaloids of the opium family; but the term has also been applied to one of the modern hydroxy-azo-naphthol dye-stuffs. In describing the matter treated of in this section, the author is well up to date, such recent introductions to commerce as Green's "primuline," and the various derivatives thereof obtainable *in situ* on cotton goods by the "in-grain" process, being included. Suggestions also as to the direction which scientific investigation might take in improving certain technical processes are not wanting: for example, in the case of indigo dyeing, it is stated that a certain amount of indigotin is always lost in the process of reduction to white indigo, and its subsequent reoxidation; the cause of the loss being obscure, its investigation would probably lead to means of preventing it which would well repay the trouble.

In every book, with the greatest amount of care and vigilance, slips and misprints will inevitably occur: thus on p. 165 it is stated that alkaloids generally have no marked alkaline reaction on phenol phthaleïn, so that the amount of acid combined in salts of morphine, quinine, brucine, aniline, urea, &c., can be ascertained by titration with standard *acid*, just as if no organic base were present: obviously standard *alkali* is intended. Similarly, on p. 234, methyl violet is described as "produced by the direct oxidation of dimethyl aniline (from dimethyl toluidine)": the production of dimethyl aniline from dimethyl toluidine is scarcely a commercial process, although the converse formation of toluidine and its homologues from methylated aniline by "intra-molecular interchange" is so. It says much for the care and attention bestowed by the author in revising that such errata are but seldom noticeable.

C. R. ALDER WRIGHT.

THE FLOATING ISLAND IN DERWENTWATER.

The Floating Island in Derwentwater: its History and Mystery. With Notes of other Dissimilar Islands. By G. J. Symons, F.R.S., Secretary Royal Meteorological Society. (London: E. Stanford, and Simpkin Marshall, and Co., 1889.)

IN this little volume, Mr. Symons calls attention to some very interesting problems connected with a curious phenomenon that can frequently be studied in our own well-known Lake District. It may at first sight seem strange that the peculiarities of this remarkable freak of Nature—for such it really seems to be—are not more widely known, or that systematic and persevering investigations, carried on by competent observers, have not long since removed all the difficulties which still stand in the way of a complete explanation of the causes to which the peculiar appearances are due. But it may at all events be hoped that—now Mr. Symons has so patiently collected and sifted the results that have been already arrived at by various investigators, and added the by no means unimportant facts he has himself observed—the reproach to British science of an imperfectly investigated and unexplained "mystery" at our very doors may at no distant date be removed.

The "history" which Mr. Symons so clearly lays before us is, briefly, as follows. As far back as authentic records can be obtained, there has appeared from time to time, in the south-east corner of the Derwentwater Lake, a small island, or islands, which, after a certain interval of time, have sunk again and disappeared. The place at which this phenomenon is exhibited is approximately the same at each reappearance—namely, a point off the mouth of the Derwent, and about 200 yards to the west of the place where the Cat Gill Beck pours its waters into the lake.

The ordinary depth of the waters of the lake at this point is about 6 feet; but the island, when it rises, appears a few inches above the level of the lake, and its surface is perfectly green with vegetation. The island is sufficiently firm to allow people to stand on it; and on one occasion a band landed on the island and played a selection of airs. The area of this island has been found to vary, on different occasions, from a few square feet up to two acres. Sometimes, several small islets have risen instead of the single one, and not infrequently the island has been found to be divided by one or more deep clefts.

Careful examination shows that the island consists of a peaty mass several feet in thickness, having its surface covered by living specimens of *Littorella lacustris*, *Lobelia dortmanna*, *Isoëtes lacustris*, and other water-plants that abound in this lake. It is also manifest that the island is merely the highest part of a great blister-like upheaval of the peat which here forms the

lake bottom; and that, when this blister-like elevation subsides, the island is submerged and disappears.

When sticks are forcibly pushed into the materials composing the floating island, abundant bubbles of gas are given off, the evolution of the gas being accompanied by the production of a very perceptible odour.

During the 150 years or more, over which the records so carefully collected by Mr. Symons extend, there are nearly forty during which appearances of the island have been noticed. Sometimes, however, intervals of as much as ten years have elapsed without any appearance of the island; at other times the island has been seen for a number of years in succession; and not unfrequently it has risen and sunk several times in the course of the same year.

The island only rises in hot weather. By far the most common period for the appearance of the island has been the months of July and August; never has it been known to appear before June 5, and only once has it remained up after October 8. An examination of the temperature-records of the lake-waters and of the atmosphere in the neighbourhood points to the conclusion that the years marked by the appearance of the island are those in which the summer has been exceptionally hot.

To come now to the serious attempts which have been made to investigate the nature and causes of this interesting phenomenon. We may pass over the hasty and crude guesses of Hutchinson, Clarke, Budworth, and others, and notice first the valuable investigation of Jonathan Otley, the author of the well-known Lake-Guide. Otley had the great advantage of the advice and co-operation of the celebrated Dr. John Dalton, himself a native of the district, who analyzed the gases collected from the "floating island." Otley and Dalton's observations were made between the years 1814 and 1830.

In 1874, Dr. Alexander Knight, of Keswick, laid before the Literary and Scientific Society of that town a series of careful observations and judicious inferences concerning the floating island; and in 1876, Sir G. B. Airy took a number of bearings on the floating island, so as to fix its exact position.

Such was the state of knowledge upon the subject when the author of the present memoir took up the investigation. In August 1884 he visited the island in company with Prof. Sylvester and some other friends, and made a set of careful investigations concerning the position and size of the island, the nature of the materials composing it, the gases given off from it, and the temperature of the water around. A second visit, in August 1886, enabled the author to see the island when at the bottom of the lake.

In September 1887, Captain Wharton, R.N., F.R.S., Hydrographer to the Admiralty, obtained a section of the island by pushing a tube through the peaty mass forming the island itself down into the lake bottom. The peat was found to rest on a layer, only a few inches thick, of a diatomaceous earth.

The gases collected by Mr. Symons, Captain Wharton, and several other observers, have been analyzed by Dr. W. J. Russell, F.R.S. The results obtained are in close agreement with those of Dalton. The gas evolved appears to be a mixture, in nearly equal volumes, of marsh gas and nitrogen, with only small quantities of carbonic acid and oxygen. Dr. Russell points out that the composition of this gas is nearly identical with that of a "fire-damp" from Killingworth Colliery analyzed by Graham.

That the "mystery" in connection with the floating island of Derwentwater still remains unsolved is freely admitted by the author of the work. It would seem that during warm weather a sufficient evolution of gases takes place to cause the peaty bottom of the lake at this point to rise in a great blister. But what are the causes that give rise to this evolution of gas at this particular spot—an operation that has been repeated many times during the last 150 years—it is not easy to suggest. Equally difficult is it to assign a cause for the appearance of this phenomenon at a definite point with such remarkable persistency, while nothing of the kind has been observed elsewhere. The peculiarities of the lake-bottom at this place which may exist and may conduce to such a result do not appear to have been as yet determined.

Mr. Symons calls attention to the numerous floating islands at many different localities, which consist of accumulated masses of vegetation that have accumulated near a shore, and have subsequently broken loose. From all such cases, as he points out, the Derwentwater Island differs in three important particulars: (1) in being usually at the bottom of the lake, and only floating for perhaps one month in four years; (2) in being a part of, and remaining continuously united with, the bottom of the lake; (3) in always occupying the same spot.

It is to be hoped that this able summary of the whole evidence bearing on the question, which has been prepared by Mr. Symons, may not only attract more general attention to a very interesting phenomenon, but induce some investigator with the necessary knowledge and leisure to make such observations as are still necessary before we can hope for a complete explanation of the exact causes to which it is to be assigned.

A JOURNEY TO THE PLANET MARS.

Mr. Stranger's Sealed Packet. By Hugh MacColl. (London: Chatto and Windus, 1889.)

A WORK of fiction, founded upon scientific facts, is interesting to us, inasmuch as it may extend, to no inconsiderable degree, the scientific knowledge of its readers. Such attempts, however, to assimilate science with fiction may have an injurious effect, unless treated by one having an intimate knowledge of the phenomena which he describes, and we have to congratulate the author of this work upon his acquaintance with the Cosmos, exhibited in this account of an imaginary journey through interplanetary space.

The many means devised by that clever author, Jules Verne, for such a journey, are too well known to need any comment here. Mr. MacColl lacks the minuteness of description peculiar to Jules Verne, but nevertheless fabricates a "flying machine" that may rank with the best products of that author's ingenuity.

The principle employed is stated as follows:—

The attracting force residing in every particle of

matter, and drawing it towards other particles, is capable of conversion into a repelling force.

A body, half of whose mass has had its attracting tendency converted into a repelling tendency, will have a specific gravity of zero, and if placed in a vacuum will neither rise nor fall.

If more than half the mass of a body has had its attracting tendency converted into a repelling tendency, it will rise into the air, and, passing the limits of the atmosphere, will continue moving away from the earth with a velocity for a time accelerated by terrestrial repulsion, but tending more and more towards uniformity as it proceeds.

The "flying machine" was constructed of a substance that had undergone such a conversion. By means of a regulator the resultant of the attracting and repelling tendencies could be turned in any direction, and so the velocity of the machine could be increased or diminished *ad libitum*.

It was in this machine that Mr. Stranger made his journey to the planet Mars, and the work mainly deals with Martian history, the customs of the inhabitants, and adventures and incidents *en route*. The two satellites of Mars were met, and their diameters, distance from their primary, and period of revolution are supposed to have been approximately measured by the adventurer. Having reached the planet in safety, a long description is given of the startling difference one would observe on attempting to walk upon a globe where the surface gravity was only three-eighths that of the earth.

The Marsians, Martians, or Marticoli, as Prof. Young would call the inhabitants of our ruddy brother, were, according to the author, living very happily under a form of Socialism; and food was almost as free and plentiful among them as the air which they breathed, because they had learnt to manufacture it from its chemical elements—oxygen, hydrogen, carbon, and nitrogen—which existed in abundance on their planet as on the earth. In this Utopia, not only were electric lights in every house and street, and the phonograph an instrument in common use, but the sound-figures drawn upon the revolving cylinder were used as the representation of speech, such characters being truly phonetic. It appears strange, however, that although the Martians had attained such a high degree of civilization, yet they had no knowledge of gunpowder or any explosive whatever, or of any kind of telescope, a circumstance which seems contrary to our ideas on the evolution of inventions.

The inhabitants of Mars were supposed to have come from the earth, and their transference was effected in the following manner. A sun, accompanied by satellites, in revolving at an immense distance round a larger sun passed very near to Mars and the earth, and caused them to approach one another. In the words of the writer, "The common centre of gravity of the four bodies must have been so situated as to have almost neutralized the resultant of the attraction of the earth and Mars towards their respective centres, so that on one part of the earth's surface the attraction of Mars would overcome that of the earth, and gently and slowly draw a body from its surface to its own; while in other parts the attraction of the earth would be more powerful and prevent this. The two planets must also have been so near that their atmospheres were mingled, and hence the transference did not result in the death of those who had thus to emigrate against their will."

Such an explanation as this, of some perplexing phenomena, shows an intimate knowledge of the laws of gravitation. Again, whilst on a visit to one of the small Martian satellites, a fragment of rock was broken off, and instead of at once falling down on the ground, as it would have done on the earth or Mars, it sailed slowly and gracefully away, until it came in contact with another rock several yards off, when it descended softly and gently to the ground with the motion of a falling flake of snow in a perfect calm—an imaginary incident in perfect accordance with the laws of gravitation. Many similar incidents are just as ably treated, and the description of a meteor is worth repeating here:—"Its general shape was globular, and before we had got close to it, it seemed a perfect sphere, but at this near distance it looked like a round mass of incandescent liquid covered all over with bubbling and boiling protuberances, which every now and then emitted huge jets of flaming gas, or, detaching themselves from the general mass, shot forth as globules of white shining liquid. We were, in fact, the spectators of the early formation of a little world, a sun in miniature, but resembling the sun rather as it was many ages ago than as it is now."

We might quote many other descriptions of phenomena all agreeing with acknowledged facts and rigid scientific principles. We refer to observations of the extreme blackness of the shadows cast by the rocks of the Martian satellite which was supposed to have been visited, the noiseless explosions of the meteor above described, the apparent motionlessness in space of the flying machine, in spite of its enormous velocity, the inferior attraction of Mars and its satellites, and the explanation of how men got transferred from the earth to Mars. Indeed, the work is as interesting to us as to the general reader, and as a means of disseminating scientific knowledge may be eminently useful.

R. A. GREGORY.

OUR BOOK SHELF.

The Uses of Plants: a Manual of Economic Botany, with special reference to Vegetable Products introduced during the last Fifty Years. By G. S. Boulger, F.L.S., F.G.S. (London: Roper and Drowley, 1889.)

THAT a good manual of economic botany is really wanted no one who knows anything of the subject will deny, and pending the appearance of a satisfactory book any contributions towards such an end must be accepted with thanks, always supposing that those contributions are trustworthy and intelligible. Articles by competent writers on the various products of the vegetable kingdom are to be found in encyclopædias, and occasionally special subjects are taken up and worked out by individual writers; but the great want is a thoroughly good book treating of the whole range of economic plants.

The little book before us, which comprises 224 pages, is not one that will help to such a desirable end.

The plan adopted by the author, of classifying the products under distinct heads, is undoubtedly the best; but it is not equally carried out in all parts of the work. Although, under "Food, Food Stuffs, and Food Adjuncts," we find the products divided under different sections, as starches, sugars, roots, fruits, &c., no attempt has

been made to classify the individual plants mentioned under each head, whether alphabetical or scientific, while those under materia medica, oils and oil-seeds, gums and resins, are placed in some sort of scientific classification of the natural orders. Nor is the produce of one plant, though of a similar character, always to be found in the same paragraph. Thus, on p. 40, under roots and tubers, the introduction and importance of the potato are referred to, then comes a paragraph on each of the following: sweet potato, yams, Jerusalem artichokes, turnip, carrot, parsnip, beetroot, onion, parsnip-chervil, salsafy, and radish; and then, on p. 43, we have another paragraph referring to the potato, especially to the disease and the recent introductions of *Solanum maglia* and *S. Commersoni*, which would have been better placed with the account of the potato on p. 41.

On p. 59 the Souari nut (*Caryocar nuciferum*) is printed *Somari* nut, and said to be Camelliaceous. Though it is closely allied to the Camellia, it would have been more correct to call it a Ternstrœmiaceous plant. It is, however, for the meagre character of the information generally that the book is unsatisfactory. The following examples, taken haphazard, will illustrate our meaning:—

"The Coriander, the whole fruit of *Coriandrum sativum*, L., is cultivated to a small extent in Essex, but is obtained mainly from the Mediterranean and from India."

"The fruits of Angelica (*Angelica Archangelica*, L.) are used in Chartreuse, and the leaf-stalks are candied as a sweetmeat" (pp. 66-67).

Also at pp. 160-61, under "Dyes and Tanning Materials," we find the following:—"Betel Nut (*Areca Catechu*, L.) is recommended by Mr. Christy." "Canaigre is the root of the Texan Dock (*Rumex hymenosepalus*, Torrey), recommended by Mr. Christy."

"Mimosa extract was sent from Australia as early as 1823, but dropped out of notice till recently. In 1880 we imported £682,296 worth of various bark extracts" (p. 161).

Though the book is stated to have "special reference to vegetable products introduced during the last fifty years," very few dates of introduction are given, and a large number of the plants referred to were known and valued before the present century.

Examination of Water for Sanitary and Technical Purposes. By Henry Leffmann, M.D., Ph.D., and William Beam, M.A. (Philadelphia: P. Blakiston, Son, and Co., 1889.)

THIS volume contains a great deal of clearly stated information in its 106 pages. The authors have succeeded in the endeavour expressed in their preface to select trustworthy and practical processes, and to exclude the description of methods not generally employed, with other matters only remotely connected with the subject. So far as organic matter in water is immediately concerned, the "albuminoid ammonia" and the "oxygen-consuming power" are relied upon by the authors. Special prominence is also given to the estimation of chlorine, nitrogen as nitrates and as nitrites (by colorimetric processes), phosphates, dissolved oxygen, and poisonous metals. A general method of quantitative analysis for technical purposes follows, including the estimation of hardness alkalimetrically, after Hehner—rejecting soap solution altogether—and the estimation of boric acid, after Gooch, as well as the constituents that invariably receive attention. A carefully compiled chapter on the interpretation of results, and a few other matters, complete the volume.

Celestial Motions: A Handy Book of Astronomy. By William Thynne Lynn, F.R.A.S. Sixth Edition. (London: Edward Stanford, 1889.)

THIS is the sixth edition of an interesting little book, which explains briefly the principal facts relating to the motions of celestial bodies, and to the dimensions of those belonging to our own system. The information has been brought up to date, and an addition of a chapter on "The Calendar" has been made. In the chapter on the sun we are told that "the solar spots are produced by tearings open of some of the luminous envelopes which surround the sun, so that we see in them to a depth below that of the solar surface." To an ordinary reader this statement would be rather misleading, since no mention is made of the absorption of the sun's light by the descent of the cooler particles on to the solar surface from the upper regions of its atmosphere, the spots thus being made to appear dark and not bright. In chapter x. a short reference is made to the refraction, propagation, and aberration of light, while in chapter xii. we have a brief sketch of the history of astronomical discovery. The book concludes with an explanation of astronomical and technical terms.

Science Examination Papers. Part I. Inorganic Chemistry. By R. Elliot Steel, M.A., F.C.S. (London: George Bell and Sons, 1889.)

THIS work, intended for teachers, consists of a series of examination papers arranged in a progressive and logical order. It is divided into two parts, theoretical and practical, and is written, as the author tells us, "not as a cram-book, but as a means of testing the student's knowledge and progress." The first part treats of questions on hydrogen, oxygen, ozone, &c., followed by a set of general questions on the above, concluding with a collection of papers taken from various examinations, such as the London Matriculation, Science and Art Department, Oxford and Cambridge Locals, &c. Part II. deals with questions on simple and mixed salts and elementary quantitative analysis. The work is one of the "School Examination Series" edited by A. M. M. Stedman, and should prove serviceable to those teaching natural science in many of our schools.

A Course of Easy Arithmetical Examples for Beginners. By J. G. Bradshaw, B.A. (London: Macmillan and Co., 1888.)

THIS is a very elementary book, suitable for the use of young boys. It consists of a collection of simple arithmetical examples. The first part deals with examples in simple and compound addition, subtraction, multiplication, division, and reduction. Part II., which has been in use for over a year in the Junior School at Clifton, treats entirely of vulgar fractions; Part III., of decimals, practice, and proportion. The various tables used throughout are given at the beginning, and the results of all the examples are collected together at the end.

The Prospector's Hand-book. By J. W. Anderson, M.A., F.R.G.S. Fourth edition. Pp. 145. (London: Crosby Lockwood and Co., 1889.)

THE general plan of this book was described on a preceding occasion, so that at present it is only necessary to notice the changes in the new issue. The work, we are told, has been thoroughly revised and enlarged. The enlargement consists of about eight pages of descriptive matter, mainly referring to South Africa; but the results of the thorough revision do not appear to be very considerable. Nearly all the mistakes and ambiguities in the original descriptions of metallic minerals are unchanged. The author calls attention to an addition descriptive of aluminium and its ores, from which we gather that bauxite is a ferruginous clay, a statement that is both original and incorrect. On pp. 94 and 96, one ton is said to contain 29,166 troy ounces, while in the table, on p. 121, 1 per cent., in an assay return, is given as equivalent to 326 ounces 13 dwts. 8 grains per ton. The latter statement is right, the former one is wrong, but the author does not attempt to explain the discrepancy. Perhaps he will do so in the next issue.

H. B.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Coral Reefs.

WITH reference to Captain Moore's two difficulties, I have to say:—(1) The position of banks around islands depends, in my opinion, on the nature of the rocks; loose material, or easily disintegrated rock, may be found either on the lee or weather side of an island. There are many examples of these banks in all positions around islands where there are no coral reefs. (2) I do not think it is the case that corals reach the surface simultaneously on all sides. What Captain Moore refers to as sunken reefs is good evidence that they do not. The great uniformity in the breadth of the reefs in some regions is, according to my view, due to the play between the forces secreting and depositing carbonate of lime, and those engaged in its disintegration and solution whenever the organisms have died. Reefs are very often non-continuous, as Captain Moore himself points out in the case of the Barrier Reef of Australia. This, too, I have explained in the same way, but taking into account local conditions. I cannot admit Captain Moore's supposition about the filling up of the lagoon around Solo, nor his explanation of the bank to the west of Ono. I have no charts with me here, so cannot at present refer to the other illustrations he has given.

Grangemuir, Pittenweem. JOHN MURRAY.

An Earthquake?

ON Friday, July 5, the inhabitants of Lyme Regis were much astonished by some noises, which took place at intervals between 11 and 11.15 p.m., and which there seems good reason to believe were caused by an earthquake. In three houses the occupiers thought that heavy pieces of furniture were being moved about, which was of course found not to be the case; and in another the inmates thought at first that something was wrong with the kitchen boiler. The noises observed consisted of a distant rumble which grew nearer till at last the windows of the houses rattled, and in some cases distinct vibrations of the houses were felt. Some have supposed that these noises were caused by guns at sea, but this seems impossible, because (1) the rattling of the windows occurred after the distant rumble, and not simultaneously as would have been the case with guns; (2) a gentleman who has had much experience in guns and firing, has declared that the noise was not like guns; (3) after making enquiries we have been unable to discover that any firing at sea took place that night; (4) although the night was still, a heavy ground swell was observed. These phenomena have not received any notice as far as we know in the public press, and it seems a pity, if an earthquake, as we believe, really took place, that there should not be some record of it.

Lyme. A. R. SHARPE.

The Excursion to the Volcanoes of Italy.

THANKING you for noting the intended excursion of geologists to the active and extinct Italian volcanoes under the auspices of the Geologists' Association and Geological Society of London, I would like to draw the attention of your readers to the remarkable changes at Stromboli which have lately occurred. New eruptive mouths have opened, and there has been an outflow of lava, a phenomenon so far unknown (so far as recorded) from 2000 to 3000 years. There is an uncertain reference to such an occurrence, but the change at Stromboli from Strombolian to Vesuvian activity is remarkable. I am also informed that the eruption of Vulcano still continues with paroxysms of greater activity. Thus the excursionists will have the advantage of seeing changes that, even for a constant resident in such a region, are rare. H. J. JOHNSTON-LAVIS.

Naples, July 15.

Seismology in Italy.

I WAS glad to see that Prof. Grablovitz had laid claim to attention for some of his other memoirs which I had not at that time seen, and which are of much value. I would especially draw the attention of seismologists to his study of the relationship of temperature and outflow of a thermo-mineral spring at Porto d'Ischia to the tides and barometric pressure.

In my article I only reviewed those memoirs placed in my hands by the Editor of NATURE, or sent to me privately. I may, however, say that as near as possible a complete review of all the papers on seismology and vulcanology published during 1888 is being prepared by me for the *Annuaire Géologique Universel* of this year. I should therefore be glad to receive any other papers on those subjects, that have not been sent to me, as soon as possible. H. J. JOHNSTON-LAVIS.

Naples, July 15.

The Earthquake of Tokio, April 18, 1889.

READING the report on this earthquake in NATURE (June 13, p. 162), I was struck by its coincidence in time with a very singular perturbation registered by two delicate horizontal pendulums at the Observatories of Potsdam and Wilhelmshaven. These instruments, which represent, with some modification, Prof. Zöllner's horizontal pendulum, were established in March 1889, for studying the slight movements of the ground. The motion of the pendulum, which is left to oscillate freely whenever its equilibrium is disturbed, is registered by the same photographic method as that employed for magnetic observations. The pendulum is in the plane of the meridian, so that any shock, the direction of which is not in this plane, will produce oscillations of the pendulum, diminishing gradually, if it is left undisturbed after the shock. The pillars supporting the instruments are fixed in a depth of 1 metre below the ground of the cellar which was chosen as a suitable place for the erection of the instrument.

During the three months from April to June, the disturbance of April 17, 18h. G.M.T., was the most remarkable which occurred The following readings of Greenwich mean time, which are best explained by the accompanying figures, are taken from the original photographs; it must, however, be mentioned that the small scale of 11 millimetres per hour does not allow a very accurate determination of time, and that an error of one minute or two is quite probable.

(1) *Potsdam.*—1889, April 17. From 5h. until 17h. 21m., great steadiness of image.

h.	m.	
17	21	First traces of disturbance.
17	39	Beginning of small oscillations.
17	54·3	Motion *suddenly* increases and reaches its maximum at
18	1	Amplitude of oscillation 154 millimetres. The amplitude then suddenly diminishes.
18	43	Maxima of oscillation.
18	58	
19	45	
20	0	Perfect steadiness of image.

(2) *Wilhelmshaven.*—Here, also, the image is perfectly steady until 17h. 30m.

h.	m.	
17	30	Beginning of small oscillations.
17	48—17 51	A short interval of perfect steadiness.
17	51	The movement *suddenly* increased, and as the light is not strong enough to mark the single oscillations, the image disappears until
18	38	when the principal disturbance reaches its end.
18	51	Maxima of small oscillations.
19	6	
19	22	
20	2	
20	7	Perfect steadiness.

If we compare these dates, it seems most probable that the moment which shows a sudden increase of motion, and is best marked on the curves, may be considered as the beginning of the principal disturbance. We thus have—

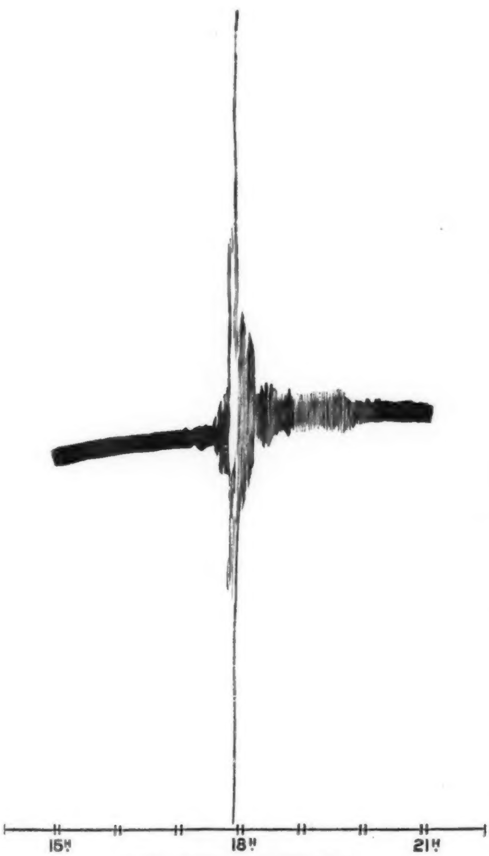
For Potsdam ... ... 17h. 54·3m.
For Wilhelmshaven... 17h. 51m. } Mean, 17h. 52·7m.,

which, considering the error of the readings, may be taken as one and the same moment.

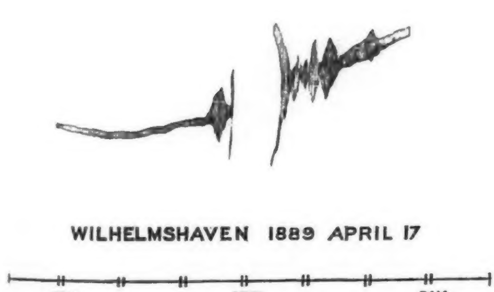
The beginning of the earthquake of Tokio was observed at 2h. 7·7m. Tokio M.T. The difference of longitude (taken from a map) being 9h. 19·3m. E., we find that the shock occurred at 16h. 48·4m. G.M.T. on April 17, and thus it took 1h. 4·3m. to travel across the body of the earth.

Taking the following longitudes and latitudes—

Tokio	139° 50′ E.,	35° 44′ N.
Potsdam	13 4 ,,	52 24 ,,
Wilhelmshaven	8 9 ,,	53 32 ,,



1889 APRIL 17. GR.M.T.
POTSDAM.



WILHELMSHAVEN 1889 APRIL 17

GR. MEAN TIME

and neglecting the ellipticity of the earth, we find the following distances:—

Tokio to Potsdam	8221 kilometres.
Tokio to Wilhelmshaven... ...	8307 ,,

Dividing the mean 8264 by 3858s., we find a velocity of 2142 metres of propagation on the straight line connecting Tokio and a place between Potsdam and Wilhelmshaven, and consequently the shock ought to have been observed at Wilhelmshaven 40s. later than at Potsdam.

The above value of velocity is between the values found by Milne from seismic experiments, viz. 900-1400 metres for different kinds of rock, and by Abbot from the effect of dynamite explosions, viz. 2800 metres. We may therefore safely conclude that the disturbances noticed in Germany were really due to the volcanic action which caused the earthquake of Tokio.

Potsdam, July 5. E. VON REBEUR-PASCHWITZ.

P.S.—I add a list of the most remarkable disturbances noticed during the course of the observations. Unfortunately, the working of the instrument at Wilhelmshaven was often disturbed by the effects of an excessive dampness in the cellar. The time is G.M.T. as above.

1889, April 5.—A day of great steadiness. A small perturbation begins at 9h. (Potsdam) and 9h. 5·4m. (Wilhelmshaven). It is divided by a short time of steadiness, 9h. 11·4m. (Potsdam) and 9h. 16·8m. (Wilhelmshaven).

April 8.—A fine disturbance begins at 16h. 45·6m. (Potsdam) and 16h. 47·4m. (Wilhelmshaven).

April 15.—A day of remarkable unsteadiness; the principal perturbation at both places lasts three hours, and lies between 7h. and 10h. It is impossible to determine a certain phase.

April 25.—A perturbation from 16h. 48m. to 18h. 12m. at Potsdam. No photograph obtained at Wilhelmshaven.

April 28.—An earthquake, consisting of one principal shock, apparently took place at 21½h.; the times noted are 21h. 34·8m. (Potsdam) and 21h. 36·6m. (Wilhelmshaven).

May 21.—A pretty large disturbance at Potsdam, lasting from 10h. 33m. to 11h. 6m., interrupted by a moment of rest at 10h. 42m. No photograph at Wilhelmshaven.

May 25.—Two very remarkable disturbances at Potsdam—7h. 9m. and 10h. 42m.—each lasting 1h. No photograph at Wilhelmshaven.

May 26.—A disturbance noticed at Potsdam, at 9h. 24m. No photograph at Wilhelmshaven.

May 30.—At Wilhelmshaven, two shocks are noticed—8h. 18·6m. and 9h. 24m.—which are probably connected with the English earthquake of this day. Perfect steadiness at Potsdam.

May 31.—A disturbance of earthquake-like appearance. Time of beginning, at Potsdam, 8h. 48m.; at Wilhelmshaven, 8h. 44·4m.; the latter time being rather uncertain, on account of the faintness of the curve.

I hope that one or other of these facts may prove to be of interest to seismologists.

On the Phenomena of the Lightning Discharge, as Illustrated by the Striking of a House in Cossipore, Calcutta.

DURING a heavy thunderstorm which passed over Calcutta about 5.30 p.m. on Saturday, June 8 last, the house of Conductor W. Viney, at Cossipore (a suburb of the city), was struck by lightning, and I have thought that a description of the phenomena connected with it might perhaps be worth placing on record in the columns of NATURE.

I was myself watching the storm from the veranda of my residence about 300 yards distant, and observed that the discharge in question was one of extreme violence. I visited the scene of the accident within a few hours, with Mr. Viney's permission taking the notes from which this account is prepared; and, owing to the exceptional opportunities for observation which obtained in this case, have been able to secure trustworthy statements as to the appearance of the discharge, and further, by inquiry, to satisfy myself upon one or two points which I believe to possess considerable scientific interest.

The house which was struck is large, square, and flat-roofed, and is occupied by three foremen employed in the Government Shell Factory adjacent: it is providedwith a lightning-conductor projecting 8 or 9 feet above the roof-level, and situated near to one end of the building, but apparently unconnected with any other portion of the roof. It is possible that a portion of the discharge passed harmlessly away by the conductor, but of this I have no evidence, positive or negative. The lightning entered Mr. Viney's portion of the house by a corrugated iron covered hatchway standing 6 feet high at the corner diagonally opposite

to the conductor, and about 70 feet distant from it in a direct line: leaving the iron cover and its wood lining untouched, it broke through the masonry, hurling portions of the brickwork to a distance of 25 feet along the flat roof; then, bridging over 3 or 4 feet of air, it reached the iron hand-rail of a spiral wooden staircase leading into the house. Incidentally, it may here be noted that this house is the nearest to the factory, which bristles with lightning-conductors at every available point; and, further, that the charged cloud would in its course pass over the portion struck before it could reach either the factory conductors or that on the house itself. Passing down the hand-rail for 11 feet, it reached a point at which metallic continuity ceased, owing to the interruption of the hand-rail; here it appears to have divided, a portion leaping along 5 feet of the wall and stripping off the plaster in patches, until it reached the second section of the hand-rail; through this it passed harmlessly, and then flew through 2 feet of space to an iron rod resting in the corner of the wall, perforating a wooden "stair-rise" on its path. The other portion discharged through about 7 feet of space in the angle of the wall direct from an iron standard, supporting the first hand-rail, to the iron rod; here, reuniting with the other portion, the whole current broke through the wall into an adjoining bedroom, and thence through the wood flooring to a sitting-room beneath. It may be observed that the spiral staircase at one time communicated with the ground-floor, but has since been filled in and covered over; there is no evidence, however, to show that any portion of the charge made earth in this direction. Within a few feet of the point where the ceiling was penetrated (but round a corner) is a broad staircase with a wooden hand-rail, supported by uprights of iron rod placed about 4 or 5 inches apart from top to bottom; but this path was not taken. Having penetrated to the sitting-room, as above described, it appears to have passed in a direction precisely opposite to that ultimately taken, and to have circled in a spiral manner around one of two brick pillars at that end of this room, and having laid bare the bricks in several places, but chiefly at a height of 4 feet from the ground, it passed across the room in which Mr. Viney was sitting with seven members of his family and friends, and upwards to the ceiling at the opposite end. Breaking through the ceiling (which is, as usual in these houses of wood, not of plaster), it burst up the boarding and singed the matting above, and again descended, but now into the dining-room on the other side of a partition wall. Here, darting diagonally downwards to the opposite wall and stripping off a large area of plaster in one place, it made for an electric bell suspended in the centre of this wall, fused the contacts, and apparently passed along the connecting wire to the battery, of which two out of six cells were shattered, and finally escaped through a return wire to a cook-house 30 yards distant in the compound. Strangely enough, these wires, although thin, are not fused, which serves to strengthen the opinion that only a portion of the charge penetrated at least into the lower rooms, even if the whole entered by the spiral staircase.

The path of the discharge from the first entrance into the sitting-room to the final exit by the bell-wire is somewhat inexplicable—especially the circuit of the brick pillar, which is said to be of solid masonry, with no iron core; it is true that a sewing-machine was standing on the further side of the pillar, but although within a few inches of the patch denuded of plaster, it appears to have been unaffected. Again, there were several metallic objects in the room—an iron chair close to the above-mentioned pillars, and a square horizontal piano with the strings parallel to the line of discharge, yet both were untouched; the occupants of the room also were practically in the same line, but were perfectly uninjured. Then, too, there was apparently nothing to lead the lightning through the ceiling boards to gain access to the dining-room in preference to an open door a few feet distant. And, lastly, it did not pass across the latter room in a direct line to the electric bell, but struck the wall about 5 feet away, tearing away the plaster and leaving upon the bricks a netted marking recalling the branching discharges of a torrent of sparks from an induction-coil or Wimshurst machine; near this point, but a few inches to one side (the bell side) and in front, was a pendent iron chain, which may have determined the charge in that direction, but shows no sign of having been touched; and immediately beneath the spot through which the lightning entered the room was standing a member of the household, who also escaped with a severe shock to the nerves and a temporary tingling sensation. Attached to the affected pillar in the sitting-room was a cuckoo clock, and this alone in that room appeared to suffer; the weight chain was taken in transit, and the clock began vigorously to chime, which it has refused to do ever since.

Mr. Viney happened to be facing in such a direction that he could watch the progress of the discharge. He describes the effect as that of an intensely brilliant ball of yellow fire, about 6 or 7 inches in diameter, which passed from one end of the room to the other at a pace just sufficiently slow to allow it to be readily followed by the eye; about half-way across, it appeared to be momentarily checked, and then, seeming to burst with a deafening report which shook the whole house, it scattered and passed onward.

About certain points he is absolutely certain: there was no premonitory warning, no sound of a brush discharge or odour of ozone, the first intimation being the entrance of the fire-ball itself. Again, the direction taken was from the staircase to the bell (that is, from cloud to earth), and the direction was uniform, and no second ball was seen to enter from the opposite side to meet the first and so produce the apparent explosion, nor after the concussion was there any other phenomenon than the passing on of the ball.

Again, it has long been known that the passage of high tension discharges through mixtures of oxygen and nitrogen induced combination of these elements; I therefore asked Mr. Viney as to the after appearances, and as to the presence of unusual coloured gases, or of a suffocating sensation. He at once said that the whole house seemed to be filled with an orange-coloured gas (mixed, of course, with clouds of dust), the breathing of which was perfectly stifling, and was equivalent to inhaling the fumes from burning sulphur. I have since asked him to report upon a sample of nitrogen tetroxide highly diluted with air: he declared that the gas in his house was of a brighter orange shade, and of a somewhat similar yet not identical odour; on presenting him, however, with a stronger mixture, he was quite confident that both in colour and in smell the two gases were identical. I am here practically confined to my own library for books of reference, but am not aware that this observation has actually been made before, although, as above stated, theory has long since ruled that such a reaction must occur during the electrical discharges of a thunderstorm. But the proof is here not only that the reaction does occur, but that a very large proportion of the oxygen in the atmosphere immediately surrounding the path of the flash must be converted into oxides of nitrogen.

The appearance of the fire-ball was only within the house. The discharge as seen from my position appeared as an almost straight ribbon of light; owing unfortunately to intervening trees, the flash could not be traced quite to the house, or the question as to the branching of the lightning on entering the house might have been definitely answered.

Several points seem to be thus clearly brought out, *e.g.*, *inter alia*, (1) the futility of partial lightning-conductor protection; (2) the apparently erratic nature of the discharge; (3) the apparent conversion of the instantaneous discharge of ribbon-lightning into the slower travelling modification of globe-lightning; (4) the formation of large volumes of oxides of nitrogen by the lightning discharge.

The above recorded observations might appear to add colour to an authoritative statement on p. 629 of Nystrom's "Pocket-book of Mechanics" (Philadelphia and London; revised and enlarged edition of 1886), where, in speaking of certain explosions, the author (or at least the printer) lays down that "the explosion of nitro-glycerine is instantaneous like that of electricity passing between two points, decomposes a small portion of the air, and explodes the nitrogen by concussion, which makes the electric spark. Thunder and lightning are explosions of a kind of nitro-glycerine formed by electricity in the air." We might even be led to indorse this both novel and ingenious explanation could we but bring ourselves to reverse existing notions as to the properties of matter and the laws of thermo-chemistry, and, at the same time, reconstruct the principles of electrical science upon a suitable basis.

The accumulation of authenticated cases such as the above is of value in throwing more light upon the vagaries of the "electric fluid" at enormous potential, and in helping to elucidate the laws under which it acts, and hence the laws which should govern the protection of buildings; and it is in the hope that this account may form a small item in the mass of evidence, that I venture to forward it for publication.

WALTER G. MCMILLAN.

Chemical Department, Shell Factory,
Cossipore, Calcutta.

The Circulation of the Atmosphere over the Equator.

ABSENCE from home has prevented my seeing Mr. Foulger's letter on this subject till to-day.

The observations on the upper winds over the doldrums, which I have described in NATURE, were taken in about 5° N. latitude and 28° W. longitude, and the whole section of the trades and doldrums lay in a line drawn from St. Vincent to Rio Janeiro.

When I stated that "low clouds from south-east flew over the north-east trade up to 15° N.," I meant to say that while the surface-wind from the doldrum to 15° N. was the north-east trade, the low or middle layers of cloud moved from south-east, all along the line of the section above noted.

Unfortunately I am unable at present to give a general scheme of the circulation of the atmosphere, though I have worked at the subject for years; and my recent observations in the Andes, from Peru to Cape Horn, throw much new light on the question.

What we do know is that the surface trades either die out at the doldrums, or unite into one moderate east current; that the low and middle currents over the doldrums are very variable, but that the wind at these low and middle levels—say 2000-20,000 feet—come usually from the south-east over the north-east trade, and from the north-east over the south-east trade; and that the highest currents—over 20,000 feet—move from east over the doldrums, from south-west over the north-east trade, and from north-west over the south-east trade. We also know that the high-level south-west and north-west winds near the equator gradually descend to the earth's surface about 30° N. and 30° S. respectively.

What we do not know is the relation of the south-east low and middle current over the north-east trade to the south-east trade on the other side of the equator, nor have we yet discovered what becomes of this middle current in the northern hemisphere. In like manner the origin and ultimate destination of the middle north-east current over the south-east trade is equally a matter for future research.

Of course, all meteorology turns round the general circulation of the air through the heating of the equatorial regions, but what I maintain is that the simple scheme which assumes nothing but an upward current over the doldrums and a return current towards each Pole is not confirmed by observation. The reality is more complex, for the centre of the high doldrum current is from the east, but diverges at the edges from south-west and north-west.

The discovery of the true nature of the general circulation of the atmosphere from the equator to the Pole—apart from any theoretical considerations—is a matter of so much importance for the future of meteorology, that I hope all future travellers across the equator will note carefully the direction of the clouds in low latitudes. I know this is somewhat difficult on board ship for want of a steady point of reference; but those whose zeal prompts them to look out between 5 and 6 in the morning, and from 6 to 7 in the evening, will usually find the moon, or some bright star, by means of which the direction of the cloud-motion can be accurately determined. Above all things, the relative, and if possible the actual, level must be carefully noted; and the observations should not be recorded as we so often see—wind north-east, clouds south-west—without any indication as to whether the south-west current is at a low, middle, or high level.

RALPH ABERCROMBY.

21 Chapel Street, London, July 22.

Changed Environment.

IT is generally known that the English sparrows were introduced into the United States on the supposition that they were insect feeders, and would protect our trees from the canker-worm. For the first time in my remembrance, I have seen one attack a caterpillar this summer. Their usual food appears to be the seeds found in horse-manure on the streets. They are now universally conceded to be an unmitigated nuisance, not doing their assigned work, and preventing others from doing it. They usurp the place of the more charming native birds, the blue-bird, the wren, and the Baltimore oriole, once common in our cities. Still, we have to confess that the sparrows are interesting little creatures, aggressive and pugnacious.

I was lately told of a circumstance, which I can myself now confirm. An "American robin" was seen watching a beetle, known here as the "June bug," that had just emerged from the ground. He tossed him about with his bill, and was closely watched by a sparrow who had alighted about a foot away. Seeing the latter, the robin at once attacked him, when the sparrow made a dive between his legs, seized the beetle and flew away. A robin rarely hunts for earth-worms, of which robins are especially fond, without being followed by one or more sparrows. These often get the worm for which the larger but less agile bird has laboured.

Another matter suggests itself to me. Mr. Wallace in his new and delightful book on "Darwinism," which reawakens one's old enthusiasm, says that many plants live "not where they must, but where they can." The natural habitat does not always appear to be the best. Thus, *Lobelia cardinalis*, so common in our Rhode Island woods, is always found on the brink of running streams, or where these *have* been, or near water. It is in such sense aquatic. But, removed to a garden, it will grow vigorously and multiply astonishingly exposed to full sunlight and in ordinary loam. Indeed, the plants prefer to escape from the beds into the gravelly paths. They will overrun a garden.

Aster Novæ-Angliæ is not one of our most abundant asters, but in a garden it will crowd out all else. The seedlings spring up even in the dry soil loved by *Plantago major*. *Viola pedata*, which grows naturally in sand, will flourish and increase in size by cultivation, becoming as handsome as a pansy. *Corydalis glauca* grows in nature on hot exposed rocks and cliffs; it will grow larger and better, and set seed abundantly, in rich loam.

I could multiply instances of such changed environment where the result was beneficial. W. WHITMAN BAILEY.

Brown University, Providence, Rhode Island, U.S.A., July 2.

Lamarck *versus* Weismann.

I SHOULD like to call the attention of those interested in organic evolution to a remarkable passage in Mr. Wallace's recent volume on "Darwinism." This work is throughout an argument in defence of Darwinian principles, in their original unmodified form as stated in the "Origin of Species," in opposition to all recent criticism or development of those principles. And yet on p. 129 the author publishes the following passage:—"Now the eyes of these fish (Pleuronectidæ) are curiously distorted in order that both eyes may be on the upper side, where alone they would be of any use. It was objected by Mr. Mivart that a sudden transformation of the eye from one side to the other was inconceivable, while if the transit were gradual, the first step could be of no use since this would not remove the eye from the lower side. But, as Mr. Darwin shows by reference to the researches of Malm and others, the young of these fish are quite symmetrical, and during their growth exhibit to us the whole process of change. This begins by the fish (owing to the increasing depth of the body) being unable to maintain the vertical position, so that it falls on one side. It then twists the lower eye as much as possible towards the upper side; and the whole bony structure of the head being at this time soft and flexible, *the constant repetition of this effort causes the eye gradually to move round the head till it comes to the upper side*. Now if we suppose this process, which in the young is completed in a few days or weeks, to have been spread over thousands of generations during the development of these fish, those usually surviving whose eyes retained more and more of the position into which the young fish *tried to twist them*, the change becomes intelligible."

A Lamarckian could accept the above passage almost without altering a word. The words I have italicized describe with absolute precision the muscular effort of the fish as the active cause, both of the individual and the ancestral metamorphosis. And yet, in chap. xiv., Mr. Wallace expresses his acceptance of Weismann's dogma of the non-inheritance of acquired characters with the words, "We cannot therefore accept any arguments against the agency of natural selection which are based upon the opposite and equally unproved theory that acquired characters are inherited; and as this applies to the whole school of what may be termed Neo-Lamarckians, their speculations cease to have any weight." J. T. CUNNINGHAM.

July 19.

Bored Stones in Boulder Clays.

STONES bored by *Pholas* and *Saxicava* are by no means rare in the shelly "Basement clay" of East Yorkshire, and I have occasionally found examples in which the shells remained in the

borings surrounded by fossiliferous sand, just as described by Mr. T. Mellard Reade from the Lancashire area. These stones are generally limestones of various kinds—Carboniferous, Magnesian, Jurassic, or Cretaceous—and the diversity of their origin seems to show that they have first been scattered over a shallow sea-bottom by floating ice, and afterwards perforated, but I do not think that they can be taken as proof of the marine origin of the boulder clay in which they now lie.

The same boulder clay contains many detached valves of bivalve shells, and these very frequently still hold a pinch of sand under the umbo, though themselves firmly embedded in hard clay; and in one case I found, under such conditions, a perfect shell (*Tellina balthica*), with valves united, enclosing similar sandy material.

It seems to me very difficult to explain by any theory of floating ice how this sandy matrix could have been preserved in the holes of the stones and under the valves of the shells, while it is easy to understand how this might take place through the agency of land ice advancing over a sea-bottom.

Before the culmination of the glacial period, while yet the ice was encroaching upon the sea-bed, and long before it had reached its greatest extension, there must have been a vast quantity of floating ice in the waters, which would drop stones and other material over the sea-bottom; and there must also have been a great extrusion of matter from the various glaciers. And as the ice advanced this material would necessarily become part of the *moraine profonde* of the glacier, and would be more or less mixed up with the old sea-bottom, but the resulting boulder clay could scarcely be called marine. G. W. LAMPLUGH.

Bridlington Quay, July 15.

Mr. Lydekker on Phenacodus and the Athecæ.

IN his article on *Phenacodus primævus* in NATURE of May 16 (p. 57), Mr. Lydekker expresses his disbelief in my opinion that that animal is nearly related to the immediate ancestor of the line of the Quadrumana, and of man. I am somewhat surprised at the positiveness of Mr. Lydekker's expression, as he must be aware of the difficulties that still surround this part of the question. What may be known about it is as follows:—

First, I have always been careful to avoid the assertion that the genus *Phenacodus* was in the direct line of descent of man. When I first traced the ancestry of the Quadrumana, I indicated the sub-order Condylarthra as its source (*American Naturalist*, 1885, p. 347; "Origin of the Fittest," 1887, p. 343), not the genus *Phenacodus*. On a subsequent occasion I restricted the range of probable ancestry to the family *Phenacodontidæ* (*Naturalist*, 1888, p. 663). In the advertisement to which Mr. Lydekker refers, I say of the *Phenacodus primævus*, "Representative of type believed to be the ancestor of all hoofed Mammalia, monkeys, and man." Mr. Lydekker's reference to this advertisement is slightly different.

Second, Mr. Lydekker objects to regarding *Phenacodus* as within the ancestry of the lemurs and man, because it appears to have no clavicle. To this proposition two replies may be made. The first is, that it is by no means certain that it had no clavicle. The second is, that if it had none it is not certain that that fact would exclude it from the ancestry of the Quadrumana; certainly it would not exclude some near ally of the same family or sub-order which possessed a clavicle. On these points I remark further.

Third, nothing can be determined from the specimens as to whether the *Phenacodus primævus* or *P. wortmani* had clavicles or not. None were found, but this part of the skeleton was disturbed in both specimens. Thus the clavicles, if present, may have been like those of some Carnivora and Rodentia, connected with the manubrium sterni and scapula by soft tissue only, and so have been readily lost.

Fourth, the presence or absence of clavicles is not important in a systematic sense. It is not available as a definition in the orders Edentata, Rodentia, Insectivora, and Carnivora, where, as is well known, it may be present, rudimental, or absent. And in the phylogenetic history of a line, I see no reason why clavicles might not lose and later recover their osseous tissue under suitable stimulation.

Finally, I believe that the Condylarthra are in the direct line of ancestry of the higher apes, so long as no better objections can be found than those raised by Mr. Lydekker. Another objection exists which he has not pointed out; viz. the absence of anapophyses of the vertebræ. But this objection loses much point when we remember that anapophyses are also wanting from the vertebræ of the anthropoid apes and man. What their status was in the anthropoid lemurs (*Anaptomorphus*) we do not yet know. Moreover, a trace of the anapophysial structure does exist in both species of *Phenacodus*, as a fold continuous from the posterior border of the neural arch over the centrum. As regards the clavicle, it is highly probable that it is present in some of the genera of the Condylarthra, and even of the *Phenacodontidæ*, such, for instance, as *Protogonia*, but we know too little of the structure of the skeletons of several allied genera, to enable us to determine the points in question. On the presence or absence of anapophyses in such genus of Condylarthra will depend the solution of the question whether the descent of man passes through *Anaptomorphus* or *Adapis*, or some other undiscovered form of Quadrumana, to the anthropoid apes.

While on this subject I refer to Mr. Lydekker's reference to my term Athecæ (Testudinata), as "ungrammatical." He declares that the grammatical form should be Athecata. Now, while the latter expression is perhaps grammatical, it is not more so than the one which I elected to use. It is probably well known to Mr. Lydekker that scientific names are written in Latin, and not in Greek. The singular Atheca, although derived from the Greek, becomes Latin by scientific use and usage, and is declined, genitive *æ*, and nominative plural *æ* also. See Latin words derived from θήκη, as Bibliotheca, -æ. I used the substantive form, which is more usual than the adjective, in making scientific names. E. D. COPE.

Philadelphia, July 1.

Systematic Position of the Characeæ.

THE position in a natural system of classification of this small and strongly-differentiated group of aquatic plants has been so long a subject of controversy, that any additional light upon it will be welcome to vegetable physiologists. I therefore desire to call the attention of my fellow-botanists to the remarkable paper by M. Guignard, "On the Development and Constitution of the Antherozoids of Cryptogams," in the early numbers of the new botanical journal edited by M. Bonnier—the *Revue Générale de Botanique*. It is true that these observations only confirm the earlier ones of Thuret; but the care with which M. Guignard has worked out the subject, and his beautiful drawings, tend to emphasize the results previously obtained.

No one who compares the drawings of the antherozoid of *Chara fragilis* in Pl. 2 with those of *Pellia epiphylla* in Pl. 3 can fail to be struck with their remarkable resemblance. Each is a long, corkscrew-shaped body, with a pair of very long and slender vibratile cilia attached to its anterior extremity. The mode of development of the antherozoid is also the same in all essential particulars in both cases, and is thus described by M. Guignard. The body of the antherozoid proceeds from the nucleus of the mother-cell, and moreover gives all the micro-chemical reactions of nuclein. The vibratile cilia are derived from the cytoplasm. A thickening band first appears on the surface of the nucleus, and grows longer and longer, forming eventually a kind of beak, and the whole nucleus becomes twisted spirally as it increases in length. As soon as the outlines of the anterior extremity of the filament are discernible, the two cilia may be perceived in the thin layer of hyaline protoplasm which is nearest this extremity. Later on, the cilia, which at first lie close to the filament, become separated from it, and the rest of the protoplasm gradually disappears, being absorbed and used up for the nutrition of the antherozoid, so that only a few granulations are left on the posterior extremity of the filament. The only difference of any importance between the antherozoids of Characeæ and those of Muscineæ is the absence in the former of a vesicle formed from the cytoplasm of the mother-cell.

If now this is compared with the figures (Pl. 5) of the antherozoids of *Fucus serratus*, and the account of their mode of development, it will be seen how wide are the differences in many essential points between the corresponding processes in Characeæ and in the higher Algæ. These facts seem to me strongly to corroborate the view which I have on several occasions ventured to bring forward, and to support by other considerations, that the Characeæ are more nearly related to the Muscineæ than to the true Algæ.

I may mention in conclusion that M. Guignard adopts the revised terminology which I have advocated, of *antherozoid* instead of "spermatozoid" for the male fecundating organs of most Cryptogams, and of *pollinoids* (or rather *pollinides*) instead of "spermatia" for the corresponding organs in the Florideæ.

ALFRED W. BENNETT.

Make-believe.

I CAN well believe in Sally meaning a joke. Animals have a keen sense of "making believe" which is the essence of *play*. A child's first game is bo-peep—a make-believe. When a pair of friendly dogs have a jolly tussle, they make believe to engage in deadly combat.

A striking instance of this occurred to me some years back. I gave a dead mouse to a kitten. It was the first time she had seen one, and she sniffed at it inquisitively before deciding on tossing it about. A pair of slippers lay on the floor. She dropped it into one of them, and *immediately* proceeded to look for it most zealously in the other slipper, till I took up the first, which contained her booty; then she showed that it was no real lack of memory that had sent her on the bootless search.

The law allowed to game, when hunted for recreation, is perhaps the most marked evidence of the make-believe element which is to be found in the play of civilized adults.

Dublin, July 16. MARCUS M. HARTOG.

Dogs and Fire.

AN unrecorded type of the pluck of the fox-terrier was demonstrated to me recently. A young dog two or three years old, the property of Mr. Doyle, of Loretto Terrace, Bray, goes for fire with as much zeal as any of his race go for rats. When a newspaper thoroughly ablaze is thrown down, he stamps upon it with frequent short rushes till it is extinguished, and then worries the scorched remains before asking for a fresh opportunity. He gets excited and keen on being shown a crumpled newspaper or a match-box.

The possibility thus shown of educating dogs to tackle fire gives additional point to my friend Dr. Sigerson's published suggestion to use dogs as companions to night-watchmen, based on their keenness of scent. MARCUS M. HARTOG.

Dublin, July 16.

"The Theorem of the Bride."

REFERRING to the last paragraph of the review of my "Greek Geometry from Thales to Euclid" which appeared in NATURE of June 20 (p. 172) it may interest some of your readers to know that since the publication of my book I have found the expression—τὸ τῆς νύμφης θεώρημα—in the Scholia on the "Elements of Euclid." See "Euclidis Elementa," ed. Heiberg, vol. v. p. 217, Lipsiæ, 1888.

The expression seems to have been a common name of Euclid i. 47. GEORGE J. ALLMAN.

Belsito, Milford, Lymington, July 18.

RECENT RESEARCHES INTO THE ORIGIN AND AGE OF THE HIGHLANDS OF SCOTLAND AND THE WEST OF IRELAND.[1]

I.

THE records of geological history, like those of the human race, become more fragmentary and illegible, the farther back we trace them into the past. While the younger rocks of the earth's crust have been made to yield a more or less connected story of geographical and biological evolution, the oldest rocks have till comparatively lately been neglected, or have been tacitly left to mere speculation and conjecture. Only within the last few years have these ancient formations been seriously and sedulously attacked by scientific methods of inquiry. Though the progress of investigation has necessarily been slow, a steady advance in knowledge can be chronicled. There is a curious fascination in this department of geology. These venerable rocks reveal to us the oldest known part of the outer shell of our planet. The palimpsest of the earth's surface has been written over again and again during the long ages of geological history; but down among these bottom-rocks we reach the earliest recognizable inscriptions, and come as near towards the beginning of things as geological evidence by itself is ever likely to lead us. These records carry us back to a time anterior to that of the oldest fossiliferous formations, possibly to an epoch that preceded the appearance of vegetable or animal life on the globe. They reveal to us the very foundations of the earth's crust, on which all other known rocks rest, and out of the waste of which the greater part of these rocks has been formed.

Within the last ten years, after prolonged misconception and neglect, the most ancient rocks of the British Isles have come to occupy a foremost place among the researches of the geologists of this country. The tracts where they are now exposed to view, often among the wildest mountains, or "placed far amid the melancholy main," have become favourite geological hunting-grounds, and have furnished a notable amount of material for those disputes and combats which seem to form a necessary element in geological progress. Avoiding, as far as possible, matters of controversy, I propose this evening to offer a brief outline of the actual state of knowledge, up to the present time, of the history of those ancient crystalline masses of which our north-western mountains are composed.[1] The story is a somewhat involved and complicated one. But its main points may perhaps be conveniently grasped, if we bear in mind that they naturally group themselves into four sections: (1) the Archæan period; (2) the Cambrian period; (3) the Lower Silurian period; (4) the period of the younger Schists.

Let me at the outset remark that in the investigation of these early ages of geological history we enjoy in this country a special advantage. The British Isles stand on the oceanic border of a great continental region. They are therefore placed along that critical belt where not only have terrestrial disturbances been especially numerous and violent from the earliest geological times, but where an oscillation upward or downward of a few hundred feet has sufficed to make all the difference between land and sea. In the heart of a continent, as, for example, over the vast plains of Russia, long cycles of geological time have passed without serious disturbance of any kind. To this day some of the ancient Palæozoic sediments in that region, for hundreds of square miles in extent, lie as level as when they were deposited on the sea-floor. They have been uplifted bodily into land, but still remain little more than mere hardened mud and sand. In Western Europe, on the other hand, where from the remotest geological antiquity the oscillations and dislocations have been innumerable, every successive continental uplift has recorded itself in some crumbling or fracture of the rocks. Hence in the geological map of that region the various formations form a pattern of exceeding complexity, while in the maps of Eastern Europe each of them covers a broad unbroken expanse.

I.—*The Archæan Period.*

The oldest known rocks of Europe, now generally termed Archæan, are well exposed along the north-western borders of the continental area from the extreme north of Scandinavia, by the west coast of Scotland, to Galway Bay in the west of Ireland, a total distance of some 1600 miles. They give rise to topographical features which, where fully developed, strongly distinguish them from all younger formations. Nowhere else can such extraordinary unevenness of surface be found. Knobs, hummocks, and ridges of bare or almost bare rock, separated by narrow gullies or by wider winding valleys, roughen the ground in every direction. In the hollows lie innumerable tarns and lakes, or flat tracts of bog where lakes once were. In some districts, indeed, there is as much water as land in a given number of square miles. On a large scale, this type of scenery is perhaps

[1] The Friday evening lecture delivered at the Royal Institution on June 7, by Dr. Archibald Geikie, F.R.S.

[1] It would be obviously out of place to include here references to the voluminous literature of the subject. A condensed summary will be found in the Report by the officers of the Geological Survey, Quart. Journ. Geol. Soc., vol. xliv., 1888.

best displayed in Finland; on a small scale, it is repeated all through the chain of the outer Hebrides, as well as on the Archæan areas of the mainland. The most southerly points in Scotland where it can be recognized are the Island of Iona and the Ross of Mull. It reappears, however, far to the south in Ireland; standing out in the bold cliffs from Erris Head to Achill Island in the west of Mayo, and finally covering an area of more than 500 square miles in South-Western Galway. In this last-named district, as Prof. Hull has shown, so completely are the scenic features of the north-west of Scotland reproduced, down even to the minutest details, that the geologist, even before he stands on the rocks, has no difficulty in deciding that they can only be Archæan.

What, then, are these most ancient rocks of North-Western Europe, and what has been their history? Unfortunately, the answer to these questions cannot be succinctly and definitely given. Owing to the antiquity of the masses, and the prolonged series of geological revolutions which they have undergone, their original characters have been somewhat effaced. In those areas where they have been least altered, and where, therefore, they approach nearest to their primitive structure, they have been found by my colleagues of the Geological Survey to be crystalline rocks, such as gabbros, diorites, and other highly basic compounds. These occur in zones or bosses surrounded by and passing into rocks which have acquired the peculiarly banded structure characteristic of gneiss. That these various rocks were eruptive—that is, that they originally formed portions of igneous material that rose in a molten or plastic condition from below—can hardly be doubted. They remind us of the deep-seated portions of some of the eruptive bosses so abundantly intruded into the crust of the earth, and now so plentifully exposed at the surface after prolonged denudation. Like these, they show a rudely striped or banded arrangement suggestive of the planes of movement or flow-structure seen in consolidated igneous material. They have probably resulted from successive protrusions of eruptive rocks at some depth within the crust of the earth.

Nowhere, however, in the region to which I am referring, has any trace of superficial eruption yet been detected. There are no true volcanic ejections, nor any evidence that the rocks, though certainly of eruptive origin, were ever connected with the ordinary explosive operations of volcanic vents. Not only so, but after the most careful search from Sutherland to Galway not a vestige have we yet found of any unquestionable sedimentary material. There are no conglomerates, no sandstones, no shales; nor even any materials that might be supposed to represent these in a metamorphosed condition. Of the actual surface of the earth these Archæan rocks afford no recognizable trace. They obviously did not form the superficial layer themselves. They must have lain deep under a cover of other material, under which they acquired their crystalline structure, and by the subsequent removal of which they have been exposed to the light.

One of the most impressive features of our recent researches among these rocks is the evidence of the magnitude of the interval of time between their original protrusion and the formation of the next group of rocks overlying them. Of the many breaks in the geological record, none is more complete than this. We pass at one step from Archæan rocks, dating no doubt from an early stage in the consolidation of the crust of the planet, to the gravelly and sandy deposits of an inland sea, which already present all the familiar characters of the sedimentary accumulations of later geological time.

Some of the more prominent events in this protracted interval may be more or less clearly discerned; others can only be dimly conjectured. Arranging in chronological order the more important which have lately been recognized by the Geological Survey, I would direct your attention to four main episodes in the Archæan history of our North-Western Highlands.[1]

In the first place, the crust of the earth over that region was thrown into a series of low arches or folds, the axes of which ran in a general north-east and south-west direction. Its component rocks were crushed and sheared, so as to acquire the banded and crumpled structure of typical gneiss. Perhaps we may trace to these primæval terrestrial movements the first shaping of the European continent, which certainly has grown from north to south. At all events, it is interesting to note that the undulations into which the rocks were thrown took that north-easterly trend which is still so marked in the long belt of crystalline schists from the North Cape all the way to the west of Ireland.

In the second place, after these early disturbances, and probably long after them, a remarkable series of manifestations of plutonic energy occurred. The region extending from the north-west of Scotland to the west of Ireland was convulsed by the production of innumerable dislocations in the solid terrestrial crust, having a general west-north-west direction. Up these gaping rents, molten basic lava rose from some subterranean reservoir, and solidified in broad dykes of black basalt. Some of these dykes can be traced for ten or twelve miles, till they run out to sea at the one end and pass under younger overlying formations at the other. Yet again, at a somewhat later period, another series of fissures was opened slightly oblique to the direction of the first; and, in these, still more basic lava formed a second series of dykes trending nearly east and west. Nor was this all, for there followed a third period of convulsion, which gave birth to a series of huge dykes of granite.

Whether or not any of the eruptive material that filled these successive fissures ever rose to the surface and flowed out there, or gave rise to the explosive phenomena of true volcanic vents, cannot be certainly affirmed. But an interesting piece of evidence points to the probability that such a connection with the surface was really established. In some of the conglomerates of the next succeeding group (Cambrian or Torridon sandstones), there occur fragments of highly vesicular lavas, which show that at some time previous to the deposit of these coarse sediments, active volcanic vents existed somewhere in the region of the north-west of Scotland. As yet, however, no trace has been discovered of any of the lava streams which flowed out at the surface.

Although volcanic energy has long been quiescent over the British Isles, probably no area in Europe exhibits within so limited a space so long and varied a record of volcanic eruptions. There is, therefore, a peculiar interest about these traces of the ancient volcanoes which in Archæan time rose along the Atlantic border in the north-west of Scotland, for they stand at the very beginning of that long history. Moreover, so far as we can interpret their remains, they seem in a curious way to have anticipated the characteristics of the last great volcanic episode in Britain—that to which we owe the Tertiary basaltic plateaux of Antrim and the Inner Hebrides. In both cases the distinguishing feature was the fissuring of the terrestrial crust and the uprise of basic lava in the rents, with the consequent production of innumerable parallel dykes trending in a general north-westerly direction.

In the third place, after the production of the basic dykes, there came another prolonged interval, during which a series of remarkable terrestrial disturbances affected the north-west of Scotland. The crust of the earth in that part of Europe was once more dislocated by innumerable fissures, produced probably at successive epochs of paroxysm, for they can be grouped into three distinct series. Of these, one runs approximately parallel

[1] Those who wish fuller details on this subject will find them in the Survey Report already quoted.

with the north-west dykes, the second trends east and west, and the third runs north-east and south-west, or north and south. So far as yet discovered, no lava of any kind welled upwards into these fissures. They are ruptures, but not dykes. They were accompanied, however, by the manifestation of another form of terrestrial energy, the geological efficacy of which has only recently been recognized. The lines of vertical fracture became also lines of horizontal or oblique movement during the vast strain of terrestrial contraction. One side was driven past the other side, and with such irresistible force that the rocks for some distance on either side were dragged into the line of movement, crushed down, and forced to assume a new crystalline arrangement of their materials. The basalt dykes, reduced sometimes from a width of 50 or 60 yards to only 4 feet or less, were changed into diorites, and where the shearing was greatest, into hornblende-schists. The gneiss, in like manner, was thrown into sharp folds, and had a newer foliation developed in it parallel with the new planes of movement.

In the fourth place, during the prolonged succession of changes which I have thus briefly summarized, there must have been in progress a continuous denudation of the surface of the Archæan land in the north-west of Europe. Doubtless, each of the subterranean disturbances more or less affected the surface. The land was by degrees ridged up above the sea, and its height and breadth were probably from time to time increased by local uplifts accompanying the disturbances. But as soon as the land appeared, it began to be attacked by the waves, the air, rain, and running water. Terrestrial convulsions were intermittent, but superficial waste continued uninterrupted. Whatever may have been the character of its topography, the first formed land, as soon as it rose, became a prey to the denuding forces, and had its original surface gradually stripped off. We have no means of telling how great a thickness of material was in this manner removed from the land before the time of the next geological period, nor for how vast a time this slow process of denudation went on. All that we can now discover is a series of detached fragments of the surface of this primæval Europe, which have been preserved by being buried under the pile of material formed out of the waste of the Archæan rocks. From these fragments we learn that the rocks had been enormously denuded so as to lay bare to the surface some of their deep-seated parts, the land shaped out of them having been carved into dome-shaped hills and basin-like hollows, not very different from those which are so characteristic of the Archæan tracts to-day.

II.—*The Cambrian Period.*

We now reach the base of the stratified formations of the British Isles, and enter upon a series of records which deal not with subterranean but with superficial changes, and in which the earliest geographical conditions of our area are more or less fully chronicled. These records consist of a pile of dull-red sandstones, conglomerates, and breccias, with grey, green, and black mudstones, marls, and shales, attaining a maximum thickness of perhaps 10,000 feet. This great accumulation, chiefly of coarse sediment, was derived from the waste of the Archæan land. The pebbles in its conglomerates are fragments of that land, and enable us to form some conjecture as to the nature of the materials that composed its surface. An examination of these pebbles brings to light the important fact that besides the detritus of the gneiss and other Archæan rocks which can now be seen *in situ*, the conglomerates are made up of materials derived from some still older sedimentary formations which have entirely disappeared from our area. These included such rocks as quartzite, greywacke, shale, and limestone, besides abundant pieces from the lavas, which I have already referred to as having probably been erupted to the surface in pre-Cambrian time. The destruction of these intervening deposits, and the chance discovery that they once existed because fragments of them have been found in later conglomerates, serve to impress upon us the imperfection of the geological record, and the vastness of the intervals of time which may sometimes separate two successive groups of rock.

The thick mass of red sandstone and conglomerate which rests directly on the Archæan gneiss forms some of the most singular scenery in the north-west of Scotland. Owing to vast denudation, which began before the next group of strata was deposited, it has been worn down into isolated mountains, which rise like a chain of colossal pyramids along the western shores of Sutherland and Ross. The almost level lines of stratification give to these eminences a look of architectural symmetry, in striking contrast with the more tumultuous aspect of the other rocks of the region, while their red tone of colour marks them out boldly from the wastes of grey gneiss below and the crags of white quartzite beyond. From the far northern cliffs of Sutherland these massive red sandstones can be followed almost continuously to the southern headlands of Skye. They reappear in great force in the Island of Rum, beyond which they are not certainly traceable. A group of highly altered grits and schists, seen under the great basaltic plateau of Gribun, on the west side of the Island of Mull, may mark their extreme southerly limits.[1] The red sandstones certainly do not come so far south as Iona, and not a trace of them has been met with in Ireland. They extend westwards across the Minch, for a small portion of them skirts the eastern shore of the Long Island. How far they may have stretched eastward cannot now be determined, for their limits in that direction have been obscured or effaced by the extraordinary series of gigantic earth-movements to be afterwards referred to. There can be little doubt, however, that they did not reach the district east of the line of the Great Glen, though they not improbably lay in thick mass over much of the country to the west of that valley.

We cannot now trace the original limits of these red rocks, yet we can hardly doubt that they never covered an area at all comparable in extent to that of the rocks below and above them. They appear, indeed, to have been accumulated in one or more basins, shut off from free communication with the open sea, where the deposition of ferruginous precipitates among the ordinary mechanical sediment could go on during the deposition of many thousand feet of rock. Such conditions of sedimentation were not very favourable to the existence of life in the waters of these inclosed basins. Nevertheless, that the waters were not entirely lifeless is shown by the discovery of organic remains on two widely separated horizons among the sandstones. These remains occur in grey and dark shales, the colour and composition of which suggest a temporary influx of water from without, and the cessation for a time of the deposition of the iron-oxide. At the lower horizon the fossils consist of calcareous rods, the organic grade of which is still in dispute; at the higher they include some doubtful impressions and the casts of worms. The fossiliferous bands are to be more thoroughly searched this summer, and it is hoped that something more determinable may be obtained from them.

Nevertheless, indistinct though these relics undoubtedly are, they may claim the interest which arises from their being at present the very oldest traces of organized existence yet found within our islands. Murchison classed the red sandstones of Western Sutherland and Ross as "Cambrian," inasmuch as he found them to

[1] My attention was called to these rocks by the Duke of Argyll, who himself suggested their possible Cambrian age. I visited them this spring, and found them to be greatly metamorphosed. They do not appear in Iona, where the base of the sedimentary series is found resting on the Archæan gneiss.

underlie unconformably strata containing what he believed to be Lower Silurian fossils. It is not improbable, however, that they belong to an older time than any of the Cambrian rocks of Wales.

That the red sandstones of the north-west of Scotland were laid down in shallow water seems to be clearly indicated by their current-bedding and ripple-marks, as well as by the occurrence of bands of conglomerate among them on many successive horizons. Yet they retain these characters throughout a depth of some 10,000 feet. We can walk over their edges and count every successive stratum for a thickness of more than 3000 feet along the sides of a single mountain. How, then, could such a continuous mass of shallow-water deposits be accumulated? I am not sure that any wholly satisfactory answer can be given to this question, which is one that arises in the investigation of various epochs of geological history. That the basins must have been due to local subsidence can hardly be doubted. We may suppose that this downward movement continued at the same time that the ridges which bounded the hollows continued to be forced upward. New shore-lines would thus be brought to the level of the water, and coarse shingle might be swept down upon previously deposited fine sediment. If occasionally the barrier between the basins and the open sea were partially submerged, the muddy ferruginous water of the inclosed tracts might be cleared out, and the denizens of the sea might for a time enter them. Possibly the grey and dark shales may mark these irruptions of the ocean.

That similar conditions of geography prevailed at that period in the extreme north-west of Europe is indicated by the fact that in Norway a group of red sandstones and conglomerates, known as the "sparagmite rocks," is interposed between the Archæan gneiss and the oldest of the fossiliferous formations. In these Scandinavian rocks we probably see traces of the extension of similar inclosed water-basins along the eastern border of the primæval Atlantic Ocean northwards among the hollows of the Archæan land.

Before the next great geological period these basins had been entirely effaced, and the geography of the region had wholly changed. This transformation is probably traceable to two causes. First, the terrestrial movements which led to the formation and continuance of the basins may in the end have caused their extinction by raising them into land, and possibly at the same time by folding and fissuring their accumulated deposits. Secondly, as soon as these deposits, whether split open or not, were exposed to the atmosphere they would begin to be worn down. That erosion took place during a prolonged period, and to a vast extent, is shown by the fact that in some places the thick cake of sandstone was hollowed out down to the Archæan platform below it before the next succeeding formations were deposited. Here again we are presented with a striking example of the imperfection of the geological record.

(To be continued.)

THE PRIVATE LABORATORY OF MARINE ZOOLOGY AT RAPALLO.

THIS very modest zoological station does not in the least pretend to compete with the splendid ones of Naples, Plymouth, Roscoff, Banyuls, &c. Considerable sums are needed to build and keep up such establishments, so that their numbers will necessarily be always very limited.

We have thought that with relatively little expense it might be possible for zoologists to procure in great part the advantages that these larger stations offer, and to concur in their action, by establishing a certain number of small stations on favourable spots of the Italian coast. Our idea is to have dependencies of the zoological laboratories of the nearest Universities, almost as if parts of those laboratories were transported to the sea-shore. The cost of these stations would not be very great. All that is strictly necessary is a room with good light, and as near as possible to the sea, provided with small aquariums, with the usual pump, with fishing apparatus, and the ordinary furniture of every laboratory, except microscopes and other costly instruments, which every investigator would bring with him. The books also might be reduced to the treatises and the "Faunæ" ordinarily used. It is indispensable that the station should possess at least one boat for short excursions: for deep dredging, and for longer excursions that are less often made, the necessary vessels could be hired.

By these modest means notable results might be obtained. Almost all anatomical and histological researches would be possible, the inquirer either making them entirely on the spot, or limiting his work to the first observations that ought to be made on specimens freshly caught, and preparing the materials for later and more leisurely study.

Stations of this sort already exist abroad, such as the laboratory of marine zoology of Wimereux, the Netherlands movable station, the station of Misaki in Japan, &c.

In Italy, Prof. Kleinenberg proposed to found a station of this kind at Messina, but of greater proportions, hoping that it might serve principally as a school for beginners; but unfortunately his idea has not yet been realized. Neither has anything come of the project of Count Alessandro Ninni to establish a station at Venice that might serve at the same time for purely scientific researches, and for practical studies on the industrial cultivation of sea animals.

Convinced of the utility of small stations, we have made an experiment in forming one which we will now describe.

Unwilling to go too far from Turin, we have chosen the little town of Rapallo on the Eastern Riviera, near Genoa. It is situated at the end of the gulf of the same name, is one hour's distance by boat from Portofino, that marks the extremity of the gulf towards Genoa. The Gulf of Rapallo is pretty well sheltered from the winds; the shores are rather rocky, and vegetable and animal life is very various and abundant. It also presents notable variations of depth. From Rapallo to the extremity of the gulf, a distance of 4 kilometres, the depth gradually reaches 90 metres, and at a like distance in the open sea of Portofino, the depth is more than 400 metres. The movement in the haven is limited, and hence the waters even near the town are clear. As to the town, it is beautifully situated, and the neighbouring places are various and very pleasant. It is also a very quiet town, where the greatest liberty can be enjoyed.

Our station occupies a space of a hundred square metres, and it is placed a few metres from the sea, on the ground where the docks formerly stood. In this space, inclosed by a wooden palisade, is the little building which looks like a *chalet*, the lower part in brick-work, with wooden walls and a roof covered with zinc. The edifice consists of only one large room, 7 metres in length, and 4·50 in width (inside). The height up to the wooden ceiling, that is under the roof, is about 4 metres. One of the longer walls is turned to the north. A window, consisting of nine large divisions, runs the whole length of this wall; and against this wall is placed the working-table, which also occupies the whole length; at it six persons can work. The door is on the shorter side that looks on the sea; over the door is placed the reservoir of sea-water capable of containing more than 800 litres; it is filled by a small rotatory pump. By means of pipes the water is brought from this reservoir into the aquariums that are placed in the middle of the

room on an iron support of two stories, provided with the necessary discharge-pipes to carry off the water that has circulated in the aquariums. Against the shortest wall, opposite that in which the door is placed, there is a table covered with porcelain for chemical manipulations. Above this table there is a reservoir of fresh water. In the middle of the room, behind the support of the aquariums, are two tables covered with marble. Against the wall opposite the window are the shelves for the instruments and for the collections. One corner is set apart for the principal fishing implements.

The station has a boat, the *Bonellia*, that serves for short excursions, and for researches in shallow water. The fishing implements consist principally of trawl-nets for the depth, nets for surface fishing, apparatus for extracting masses from the bottom, sieves, nets, harpoons, &c. These implements have been made expressly at Naples, under the supervision of Dr. Paolo Mayer, of the Zoological Station.

The station is also provided with numerous aquariums for study, and with the necessary chemical apparatus. The library is limited to the more common and useful treatises, and to a certain number of memoirs concerning the marine fauna.

We hope that even by these simple means it will be possible to obtain satisfactory results. Many important works on marine zoology have been produced far away from zoological stations under less favourable conditions than those of our little station.

L. CAMERANO.
M. G. PERACCA.
Zoological Museum, Turin. D. ROSA.

WEISMANN ON THE INHERITANCE OF INJURIES.[1]

IN an address to the Naturforscher-Versammlung at Cologne, last autumn (now published in a compact pamphlet of fifty-two pages), Dr. Weismann examined the evidence for the inheritance of injuries. In earlier works he has shown that the facts of organic evolution can be explained without the hypothesis of the inheritance of acquired characters, and his theory of the germ-plasma as the basis of heredity is hardly compatible with the traditional and Lamarckian view. The supporters of the old view have laid great stress upon the transmission of the effects of injuries. A great many of the cases relied on rest on merely anecdotal evidence, and Weismann examines and dismisses many types of them. Such, for instance, is the case adduced by Dr. Zacharias, and quoted by Eimer, of a tailless cat which produced tailless kittens. Nothing whatever of how the mother lost her tail is known, and nothing is known of the father. Tailless kittens appearing suddenly in villages have been traced, more than once, to an imported male of one of the many tailless breeds. In any particular case, it is as logical to refer the appearance of tailless kittens to a hypothetical mutilation of the mother, as it would be to deduce from the many-toed Oxford cats that Mr. Poulton had fixed additional toes on the paws of their ancestor!

Weismann made an elaborate series of experiments on mutilation. On October 17, 1887, he had the tails removed from seven female and five male white mice. On November 16 the first brood appeared. These, and all subsequent broods, were removed from the cage. Up to December 17, 1888, 333 young were born, and in none of them was there any sign of the mutilation being inherited. In cage 2, fifteen young, of December 2, 1887, were placed, their tails having been removed. These, up to December 17, 1888, produced 233 young, all with normal tails. In cage 3, fourteen young of the second generation, with tails removed, were placed; and up to December 17, 1888, they produced 141 young, all quite normal. The experiment was carried, with a negative result, down through five generations of mutilated animals. The length of tail of new-born mice varies from 10·5 millimetres to 12 millimetres. In the series of experiments, 849 young were produced by mutilated progenitors, and in no case was a mouse produced with its tail less than 10·5 millimetres.

The author points out that, while it might be said that experiments through a far greater number of generations were needed, the so-called cases of inheritance of mutilation all imply that the mutilation is impressed on the immediately following generations. A mother breaks her finger, and her daughter has the joint of the corresponding finger imperfect. A cow has her horn torn off, and, in due course, gives birth to a one-horned calf.

Moreover, there are many cases of mutilations which have been made for hundreds of years without result. For instance, Settegast shows that all the crows but the rook have bristly feathers on their beaks. Rooks, too, have these feathers while nestlings; but, later on, they lose them by perpetually pushing the beak into the ground in search of food.

There are a great many cases which at first sight appear to prove the inheritance of injuries. As an example of how easy it is to be deceived, Weismann relates that a friend had a vertical scar (with comb-like striæ) on the left ear, the result of a sword-wound. On the left ear of this gentleman's daughter was a curiously similar marking. But it was ultimately noticed that on the right ear of the father was an appearance precisely similar to that on the left ear of the daughter. On closer examination of the father's left ear there was seen, under the scar, a linear streak, from which the striæ ran, forming a comb-like structure. It was this, doubtless a congenital variation, and not the accidental scar, that the daughter had inherited.

It is impossible to give, by extracts, an adequate conception of Dr. Weismann's ingenious analysis and masterly collation of evidence. There is enough in it to satisfy the most conservative of biologists (at least without a theory) that the transmission of injuries must be handed for ever to the "scientific novelist" and the jaded melodramatist. With them it may flourish, and rescue many a doubtful heir, and secure the happiness of many a heroine in the third volume, or before the curtain falls.

It is not so certain that all will admit Weismann's contention that the demolition of the inheritance of injuries furnishes strong presumptive evidence that acquired characters are not inherited. It might well be urged that there is a great distinction between characters which are obviously not useful (such as injuries) and useful characters. It is clear that if acquired characters are inherited it would be of the highest utility if the inheritance were selective. The tiny piece of ancestral germ-plasma increases exceedingly during the ontogeny. Has the distinction between germ-plasma and somatic plasma passed sufficiently out of the region of theory to let us infer, from the non-reflection of injuries during the process of growth, that all acquired characters are not reflected? Can we hold that, were acquired characters reflected, injuries too must be reflected? It is a question, on the one hand, of the nice adjustment of fine probabilities; on the other, of elaborate, long-continued, and specially directed observation. But, whatever is the final answer of science, this essay will be not the least of the author's many valuable contributions to it.

P. C. M.

[1] "Ueber die Hypothese einer Vererbung von Verletzungen." Von Dr. August Weismann, Professor in Freiburg i. Br. (Jena: Gustav Fischer, 1889.)

COAL AND TIN DISCOVERIES IN WESTERN AUSTRALIA.

MR. HARRY P. WOODWARD, Government Geologist for Western Australia, sends, under date May 28, 1889, some interesting particulars of both coal and tin discoveries in that colony. He writes:—

"From Vasse I made for the Lower Blackwood River Bridge, over the foot of the Darling Range, and so on to the Donelly River. On the south coast, where a small stream flows out, called the Fly Brook, coal has been found of a very good quality, but there is no port nearer than Albany or Vasse, and this latter is not a good one. There seems to be a line of coal-bearing country between the coast-range, which runs north and south from Cape Leeuwin to Cape Naturalist, and the main highlands, the southern continuation of the Darling Range; much of it covered with sand and swamps at the surface, but under which I believe we shall find coal-measures which may, in fact, extend west beneath Perth to the Irwin River, but this can only be tested by deep borings.

"There was nothing to be seen of the coal or rocks, as they are boring with a 'jumping-drill,' which reduces everything to mud, but there is one 5-foot seam and several smaller, averaging 17 feet of coal in 200 feet of rock. There are two or three outcrops in the bed of the Creek of a much weathered but good coal, some of which is highly bituminous. From Bridgetown I went to Albany, and thence east 200 miles to the Phillip River, and saw the Fitzgerald Coal-field. This is only brown coal or lignite of no value, but there is some good-looking gold-bearing country near it."

TIN-ORE.—In reference to the tin discoveries, Mr. H. P. Woodward writes:—

"From Bunbury I went towards the Upper Blackwood, to a place called Bridgetown, where tin has been found. Little work has been done yet, but, as far as I am able to judge, it seems to indicate the biggest thing of the kind that has ever been found. One shaft, 18 feet deep, will wash all the way down at about 4 or 5 pounds to the pan, and they have not got to the bottom of it yet. The richest works in other colonies are rarely more than 2 or 3 feet deep. Tin has been found at the surface, in the sand, over an area of about 100 square miles, but no sinking, except the one shaft, has yet been made; and as the surface is covered, either with sand or clay-ironstone, the formation cannot be seen at all. The late Mr. Edward T. Hardman suggested that tin would be found here. The shaft shows a few inches of soil or alluvium with gravel containing tin, where it was first found, resting on hard masses of clayey ferruginous sandstone, about 1 foot thick, then coarse quartz-grit with stream-tin and tourmalines and a few 'colours' of gold. 17 feet not gone through yet, as there was too much water, about $\frac{1}{8}$ in weight being tin-ore." H. W.

NOTES.

THE Committee appointed to consider the basis upon which the grant of £15,000 a year for University Colleges in Britain should be distributed have recommended that the grant should be divided as follows:—To Owens College, Manchester, £1800; to University College and King's College, London, £1700 each; to Liverpool University College, £1500; to Mason College, Birmingham, the Yorkshire College, Leeds, and Nottingham University College, £1400 each; to Bristol University College, the Durham College of Science, Newcastle-on-Tyne, and Firth College, Sheffield, £1200 each. The Committee are of opinion that University College, Dundee, should be dealt with in connection with the Scottish Universities, and especially with the University of St. Andrews; but they recommend that it should for the present year have a grant of £500.

A TESTIMONIAL is to be presented to Prof. Kennedy by his former students on the occasion of his resignation of the Chair of Mechanical Engineering at University College, London. A committee has been appointed to receive subscriptions, and no doubt many persons will be glad to have this opportunity of expressing gratitude for the profit they have derived from Prof. Kennedy's instructions. The Chair from which he is retiring he has held during the last fifteen years.

IN answer to a question put by Mr. Acland in the House of Commons on Monday, Mr. W. H. Smith said the Government were aware of the great interest taken by the country in technical education, and the pressing importance of dealing with it. They had been engaged during the previous few days in endeavouring to find some solution of the difficulty which surrounds the question in regard to elementary schools, but, he regretted to say, without success. The Government therefore proposed to introduce at once a measure dealing with the higher branch of the subject.

AT a general meeting of Welsh members, held at the House of Commons on Tuesday, for the purpose of conferring with Sir W. Hart-Dyke on the Intermediate Education (Wales) Bill, the Vice-President of the Council announced that, provided all the amendments on the paper were withdrawn, the Government were willing to accept an arrangement whereby the Education Council to be constituted under the Bill should consist of five members—three to be nominated by the County Councils, and two by the Education Department. Were the meeting to agree to this, then the Government would use their best efforts to pass the measure into law before the end of the session. The proposal thus made was debated at some length, and was finally adopted.

THE half-yearly general meeting of the Scottish Meteorological Society was held yesterday in Edinburgh. The Council of the Society presented its report, and the following papers were read:—"Proposed Investigation of the Numbers of Dust Particles in the Air at the Ben Nevis Observatory," by Prof. Tait; "The Distribution of Temperature over the Globe," by Dr. Buchan.

AT the last meeting, this session, of the Royal Society of Edinburgh, the Chairman, Prof. Chrystal, in closing the business, said that, during the period, 86 papers had been read, of which 21 had been in the department of natural philosophy, 16 in mathematics, 7 in chemistry, 2 in geology, 6 in zoology, 6 in botany, 23 in physiology, 2 in astronomy, and 3 in meteorology. A good number of these papers had come from the newly-instituted laboratory in the College of Physicians, and he congratulated that body on the public spirit manifested in the opening of the laboratory, and on the excellent results that followed. Eighteen new members had been added to the roll, the average in the three previous years having been 36; and 7 ordinary and 2 honorary members had been lost by death.

THE floral *fête* of the Royal Botanic Society, held on the 15th inst., to celebrate the jubilee, is a fitting occasion to recall the memory of the founder, Mr. Philip Barnes, who originated the idea, and planned and carried into execution the installation of the Society. The faculty of creation is not given to everyone. Due honour should therefore be given to those who, endowed with it, use it for the interest of science and the public good.

AT the Congress of Physiological Psychology, to be held in Paris (August 5–10) the following subjects will be discussed: muscular sense; *rôle* of movements in formation of images; is the attention always determined by affecting states?; statistical study of hallucinations; the appetites in idiots and imbeciles; are there in insane persons motor impulsions independent o

images and ideas?; psychical poisons; heredity; heredity of emotional phenomena and their expression; heredity of peculiarities in the perception of colours; heredity of special memories and of special aptitudes (technical, artistic, scientific); psychological analysis of some genealogical tables; hypnotism; causes of errors in observation of phenomena of hypnotic suggestion; normal and hypnotic sleep; motor power of images in hypnotized subjects, and unconscious movements (automatic writing, &c.); doubling of personality in hypnotism and mental alienation; phenomena of transfer; precise terminology in questions of hypnotism. (Communications to M. Richet, 15 Rue de l'Université, Paris.)

THE Leaf-insect of the Seychelles lately living in the Zoological Society's Insect House, which we figured in our issue of May 30 (p. 105), has unfortunately died, before attaining complete development. But specimens of two other scarce Orthopterous insects have lately been added to the collection. Many examples of one of the curious Stick-insect (*Diaphemora femorata*) of North America have lately been hatched from eggs received from Mr. Williams, of Toronto. The young insects are feeding well on the leaves of the common hazel and grass, and some of them have already attained a considerable size, while others are still emerging from the ova. Besides these, two examples of a very singularly shaped form of Mantidæ from South Africa (*Harpax ocellata*) have just been received from Colonel J. H. Bowker, of Durban, and appear likely to do well. A third object of considerable interest, lately lodged in the Insect House, is a fine example of the Cocoa-nut Crab of the East Indies (*Birgus latro*), presented by Commander Alfred Carpenter, R.N. This is a terrestrial Crustacean of peculiar structure, which subsists entirely upon vegetable food, and is said to be able to open cocoa-nuts. Darwin has given an interesting account of its habits in his "Naturalist's Voyage," and Prof. Moseley met with it in one of the Philippine Islands during the voyage of the *Challenger*. The Zoological Society's example appears to prefer bananas to other food, but has also eaten some lettuce.

M. DESCHAMPS, a French zoologist, has, says the *Ceylon Observer*, arrived at Colombo from Singapore. He has been sent out by the French Government to study the zoological features of the Laccadive Islands, but as it is almost impossible to reach them during the south-west monsoon, he will spend two or three months in Ceylon, during which time he hopes to pursue his researches in various parts of the island. About October he will make his way to the Malabar Coast, and from thence to the Laccadive Islands.

THE Government Geologist of New South Wales has prepared a map showing the areas within which artesian water-supplies may be bored for with good prospects of success. Water-bearing formations extend for 60,000 square miles in the arid parts of the colony, where permanent supplies are most needed; and the system of artesian wells is being widely adopted throughout Australia with the most satisfactory results. Large tracts of good pastoral country, which have hitherto been totally valueless through the want of a regular water-supply all the year round, are now capable of supporting flocks and herds.

THE Audubon Monument Committee of the New York Academy of Sciences complain that as yet comparatively few members of the Academy have given anything towards the erection of the proposed monument to Audubon. The considerable sum already received has come mainly from others. The plans accepted by the Committee will require from $6000 to $10,000 for their execution. Up to the present time, about $900 has been received. The Committee have issued a portrait of Audubon, suitable for framing, a copy of which will be sent to everyone who contributes to the fund to the amount of a dollar or more.

ACCORDING to an official notification of the trustees of the "Schwestern Fröhlich Stiftung" at Vienna, certain donations and pensions will be granted from the funds of this charity this year in accordance with the will of the testatrix, Miss Anna Fröhlich, to persons distinguished in any branch of science, art, or literature who may be in want of pecuniary support through accident, illness, or infirmity consequent upon old age. The grant of such temporary or permanent assistance in the form of donations or pensions is, according to the terms of the foundation deed, primarily intended for Austrian artists, literary men, and men of science, but foreigners of every nationality may benefit by the fund provided they are resident in Austria. Austrian subjects residing in England, who may desire to make application for a grant, can obtain all necessary information at the Austro-Hungarian Embassy in London.

ACCORDING to a telegram from New York, dated July 20, there had been slight shocks of earthquake at Memphis and in the vicinity.

THE Pilot Chart of the North Atlantic Ocean for July shows that two well-defined depressions moved up along the American coast during June. One originated over the Bahamas, on the 1st, whence it moved about north-north-east, accompanied by moderate gales, and disappeared in New England on the 5th. The other was a typical West India hurricane in every respect except violence; it first appeared south-west of Jamaica on the 14th. Heavy rainfall accompanied the passage of the storm, and caused great damage in Cuba, and on the 20th the depression seems to have united in Canada with another from the Lake region, and the combined storm moved east-north-east over Labrador, and out to sea. Much fog was encountered during the month, and many icebergs were reported between the 40th and 50th meridians, and as far south as 42° 54′ N., showing a marked southerly drift. The fact that the fog-belt is apt to overlap the iceberg region at this season makes navigation dangerous over the Transatlantic lines. One of the wrecks has an interesting history. The Italian barque *Vincenzo Perrotta*, abandoned on September 18, 1887, began her remarkable drift in about lat. 36° N., long. 54° W., and when last reported, on April 4, 1889, was about sixty miles north of Watling's Island, in the Bahamas, having made a distance of about 1400 miles in a south-west by west direction in little more than a year and a half.

AT the meeting of the Linnean Society of New South Wales, on May 29, Mr. C. T. Musson exhibited the leg of a pigeon to which a ball of earth, weighing, when dry, 9 grains, was found adhering. It would be hard to find a more striking illustration of the way in which birds may be the means of dispersing seeds. Mr. Musson also recorded a case in which a land snail (*Vitrina* sp.) was found adhering to the elytron of a beetle, whereby its migration beyond its normal habitat was to a limited extent rendered possible.

IN an article on "Blindness and the Blind," in the current number of the Journal of the Franklin Institute, Dr. Webster Fox refers, among other things, to the need for care being exercised with regard to the eyes of young children. The eyes are more sensitive to light in childhood than in adult life, yet a mother or nurse will often expose the eyes of an infant to the glare of the sun for hours at a time. Dr. Webster Fox holds that serious evils may spring from this, and he even contends that "the greater number of the blind lose their sight from carelessness during infancy." From the point of view of an oculist, he protests against the notion that children should begin to study at a very early age. He thinks that until they are between seven and

nine years old the eye is not strong enough for school work. When they do begin to learn lessons, they "should have good light during their study hours, and should not be allowed to study much by artificial light before the age of ten. Books printed in small type should never be allowed in school-rooms, much less be read by insufficient light."

In the new volume of the Transactions and Proceedings of the New Zealand Institute there is an instructive paper by Mr. A. Reischek on the wandering albatross (*Diomedea exulans*). Towards the end of January 1888, he had an opportunity of watching this bird closely among the hills of one of the Auckland Islands. Starting in search of some specimens, he was lucky enough, after a good deal of climbing, to come to a slope where a colony of albatrosses had established a breeding-place. The birds were scattered about among the tussock-grass, sitting on their nests, and from their white plumage could be easily distinguished from the vegetation at a great distance. Mr. Reischek found that their nests are always placed on sloping ground, and always on the most exposed side of the hill. The nests are composed of earth and grass cemented together, and are built in the form of a cone. They are usually about 2 feet in diameter and about 18 inches high. Outside they are surrounded by a shallow drain, intended to carry off the surface-water. Within is placed a single egg. This is white, with a few brown spots on the broad end, and measures about 5·5 inches in length by 3·1 inches broad. In most cases he found the female on the nest, the male bird standing close to her, and occasionally feeding her. Sometimes the male relieved the female, but they never both leave the nest until the young one is able to defend itself against the skua gull, a rapacious bird which devours every egg or nestling left unprotected. When Mr. Reischek approached an albatross's nest, the bird seldom left it, but set up a croaking noise, clapping its mandibles together and biting at the intruder. If it was turned off, and the egg taken, it returned and sat on the nest as before. The eggs were quite fresh on January 25, and good for eating when fried.

A vocabulary of physical terms, styled "Butsurigaku Jutsugo Jisho," has been issued in Japan. It gives the authoritative Japanese equivalents of an important group of Western scientific terms. In all, thirty-six Japanese gentlemen have been engaged in its preparation for the past six years. The Mathematical and Physical Society of Japan bears the expense of publication. The book consists of four parts arranged alphabetically under the four languages, Japanese, English, French, and German, each part extending over ninety octavo pages, and each page comprising from twenty to twenty-five distinct terms expressed in the four languages. This work, on which so much labour has been expended, can be purchased for the moderate sum of a dollar and a half.

Messrs. Macmillan and Co. have issued a "Syllabus of Modern Plane Geometry," by the A.I.G.T. The first few sections deal with harmonic ranges and pencils, the properties of the triangle, and properties of the complete quadrilateral and quadrangle; sections v., vi., and vii., with the properties of circles and geometrical maxima and minima; sections viii. and ix., with cross ratios, involution, and reciprocal polars and projection. The various subjects are treated concisely, and the work will be very useful to students.

"Hampstead Hill," a work on the natural history, &c., of Hampstead, will shortly be published by Messrs. Roper and Drowley. The contributors to the various sections include Prof. J. L. Lobley, H. T. Wharton, Rev. Dr. Walker, and J. E. Harting. The book will be illustrated by engravings of local scenery.

The second part of Charles Fabre's treatise on photography has just been published (Gauthier-Villars, Paris). The subject of lenses is continued in great detail, and it is not too much to say that a more complete account has never been written. Diaphragms and instantaneous shutters are begun in this part. The illustrations are excellent.

The Royal Physical Society of Edinburgh has issued its Proceedings during the session 1887–88. The volume includes, besides an opening address, by Prof. Duns, Vice-President, the following papers:—An ornithological visit to the Ascrib Islands, Loch Snizort, Skye, by John Swinburne; on the structure of the Graafian Follicle in *Didelphys*, by Frank E. Beddard; notes on Carboniferous *Selachii*, by Dr. R. H. Traquair, F.R.S.; further notes on Carboniferous *Selachii*, by Dr. R. H. Traquair, F.R.S.; notes on a visit to Fernando Noronha (with plate), by George Ramage; on a new Eurypterid from the Upper Coal-measures of Radstock, Somersetshire (with plate), by B. N. Peach; synthetic summary of the influence of the environment upon the organism, by J. Arthur Thomson; on the prevalence of Eurypterid remains in the Carboniferous shales of Scotland, by James Bennie; on the fructification of two Coal-measure ferns (with plate), by Robert Kidston; on the fructification and affinities of *Archæopteris hibernica*, Forbes, sp., by Robert Kidston; notes on the equipment of the Research Laboratory of the Royal College of Physicians, Edinburgh, by Dr. G. Sims Woodhead; the summer birds of Shetland, with notes on their distribution, nesting, and numbers, by Harold Raeburn.

The July number of the *Board of Trade Journal* describes, from certain Austrian technical periodicals, the condition of pharmacy in Bulgaria. Most of the departmental capitals, towns of 9000 to 10,000 inhabitants, but including very often an administrative area of 60,000 to 70,000 inhabitants, have only one pharmacy each. These pharmacies might be supposed to do a splendid trade, and they would do so but for the fact that the illegal exercise of the craft, in spite of the stringency of the laws which are intended to protect the legitimate professors of the art, is almost openly practised throughout the country by itinerant hawkers, quacks, and priests. The establishment of pharmacies is only allowed by special concession, and they are subject to a Sanitary Council at Sophia composed of several members, including a chemist and a veterinary surgeon. Nominally there should be a pharmacy for every 8000 inhabitants. Every Bulgarian citizen who has passed the necessary examination is entitled to compete for a concession, but foreigners are only allowed to do so when they can show that they have been qualified in their own country, and after having passed a formal examination in Bulgaria. At least twice a year every pharmacy is officially inspected by the authorities, and subjected to a close examination, which also extends to the books, as there is an official scale of charges for prescriptions which may not be exceeded. The original of every prescription is kept by the pharmacist, who gives his customer a copy stamped with his name, and bearing the price charged, which price is also inscribed upon the original, and the same number given to both. At present the Russian Pharmacopœia is used in Bulgaria, but a native one is in contemplation. There is no Pharmaceutical Society or organization of any kind among pharmacists. A Society which was started about five years ago expired after an existence of three months. The formal examination which is obligatory for foreigners desirous of establishing business in Bulgaria embraces pharmacology, analysis, organic and inorganic chemistry. The fee is very high, £40, half of which is refunded in case of failure. Every foreigner establishing business in Bulgaria is required to sign a declaration placing him under the Bulgarian Pharmacy Law, and to keep at least two apprentices of Bulgarian nationality. The assistants are nearly all foreigners, They generally receive from £2 10s. to £3 per month indoors.

THE barium salt of a new acid-forming oxide of cobalt, CoO_2, corresponding to the black dioxide of manganese, MnO_2, has been obtained by M. Rousseau, and is described in the current number of the *Comptes rendus*. It forms large black prismatic crystals, and appears to be a very definite compound of the composition $BaO . CoO_2$, and possessing some stability. The most favourable method of preparing it is as follows. A mixture of 15 grams of crystals of barium chloride or bromide with 5 or 6 grams of finely-powdered anhydrous barium oxide is heated gradually to redness in a platinum crucible. The temperature is then raised in a good furnace to 1000°–1100° C., when 1 gram of sesquioxide of cobalt, Co_2O_3, is introduced by degrees into the fused mass, and the temperature maintained for about five hours. At the expiration of this time a ring of large black prisms, exhibiting beautiful iris-coloured reflections, is formed. The crystals are found to contain a little platinate of barium, owing to the platinum crucible being attacked at the high temperature, but after elimination of this impurity the analyses agree very closely with the formula $BaO . CoO_2$. The crystals of this monocobaltite of barium are soluble in cold concentrated hydrochloric acid with evolution of heat, and dissolve likewise in nitric acid with effervescence. At a higher temperature than 1100° they are decomposed with evolution of oxygen gas, the CoO_2 becoming reduced to a lower oxide, probably Co_3O_4, the usual product of the ignition of cobalt oxides. Hence the necessity for keeping the temperature below 1100° during the preparation. If the fusion be simply performed over the Bunsen lamp, another cobaltite is obtained containing two molecules of CoO_2. A crust of crystals of this second compound, $BaO . 2CoO_2$, is formed over the surface of the melt, consisting of brilliant black hexagonal lamellæ. These crystals are likewise soluble in hydrochloric acid with evolution of chlorine gas. In order to avoid the formation of this di-cobaltite it is necessary to maintain the temperature over 1000°, when the neutral monocobaltite is alone produced. Hence the limits of temperature during which the monocobaltite is produced are 1000°–1100°. Thus cobalt resembles manganese in forming a dioxide, capable of liberating chlorine from hydrochloric acid and combining with basic oxides to form cobaltites analogous to the manganites. But this dioxide of cobalt appears from its reactions to be somewhat weaker in its combinations than manganese dioxide, and to form them with greater difficulty, the barium cobaltites above described being as yet the only ones prepared.

THE additions to the Zoological Society's Gardens during the past week include two Crested Porcupines (*Hystrix cristata*), a Desert Buzzard (*Buteo desertorum*), two Natal Francolines (*Francolinus natalensis* ♂ ♀) from South Africa, presented by Captain Henry F. Hoste, R.M.S. *Trojan*; a Common Wolf (*Canis lupus*, juv.) from Provincia de Leon, Spain, presented by Mr. W. S. Lart; four Violaceous Night Herons (*Nycticorax violaceus*), a Green Bittern (*Butorides virescens*), a Dominican Kestrel (*Tinnunculus dominicensis*), a —— Pigeon (*Columba*, sp. inc.) from St. Kitt's, W.I., presented by Dr. A. P. Boon, C.M.Z.S.; two Ocellated Mantis (*Harpax ocellata*) from South Africa, presented by Colonel J. H. Bowker, F.Z.S.; a Wapiti Deer (*Cervus canadensis* ♀), a Peacock Pheasant (*Polyplectron chinquis*), eight Mandarin Ducks (*Æx galericulata*), five Summer Ducks (*Æx sponsa*), two Chiloe Wigeon (*Mareca chiloensis*), six Chilian Pintails (*Dafila spinicauda*), three Australian Wild Ducks (*Anas superciliosa*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE BINARY γ CORONÆ BOREALIS.—Prof. Celoria has recently determined (*Astr. Nach.*, 2904) a new orbit for this difficult binary (Σ 1967), which appears a decided advance upon that of Dr. Doberck's, published twelve years ago. A considerable uncertainty still attaches, however, to the elements, although the star has now been under observation for sixty-three years, and has been watched through nearly three-fourths of a revolution. This is due partly to the circumstance that the orbit is presented to us nearly in profile, and partly to the closeness of the two components. The measures in both elements, therefore, have been difficult to make, and have often been very discordant. Thus some recent position-angles by Engelmann show a systematic difference of 30° or more as compared with measures made at about the same epoch by Schiaparelli and Perrotin. The companion passed its primary on the north side about 1836, reappearing in 1840 on the preceding side. It re-passed the principal star on the south about 1878, and is now again on the following side. Celoria's new elements compare with Doberck's as follows:—

	Doberck.		Celoria.
T	= 1843·70	...	1840·508
☊	= 110° 24′	...	113°·47
λ	= 233° 30	...	250·68
γ	= 85° 12′	...	81·66
e	= 0·350	...	0·34827
a	= 0″·70	...	0″·63103
P	= 95·50 years.	...	85·276 years.

ECLIPSES AND TRANSITS IN FUTURE YEARS.—The Rev. S. J. Johnson, author of "Eclipses Past and Future," and well known as a calculator of eclipses, presented a large manuscript volume to the Royal Astronomical Society a few months ago containing projections and diagrams of eclipses from the year A.D. 538 to the year 2500. He has now published in a little pamphlet the dates of all the eclipses, both of sun and moon, visible in England from 1700 to 2000, with the solar eclipses for the two following centuries, and the larger solar eclipses up to 2500. The transits of Mercury and Venus are also included, of Venus up to 2500, and of Mercury to 2000.

The twentieth century is distinguished by three years in each of which seven eclipses take place. Of these, Mr. Johnson notices two, 1917 and 1935, the latter being particularly noteworthy as showing five solar eclipses, but does not mention the third case, 1985, though calling attention to the rare occurrence of three total eclipses of the moon which fall that year.

The little pamphlet, which is intended as a kind of supplement to the author's larger work, "Eclipses Past and Future," is illustrated by four pages of diagrams showing the greatest phases of the eclipses up to 1949, as seen from London. The diagrams are nowhere explained, and no indication is supplied as to which are solar and which lunar eclipses. It appears that circles on which the eclipsed portion is shown by deep shading, and which are surrounded by a ring of shade, stand for solar eclipses, the plain circles for lunar eclipses.

THE WHITE SPOT ON SATURN'S RING.—M. Terby, who still strongly contends for the reality of the bright white spot next the shadow of the planet on Saturn's ring, quotes, in the *Astronomische Nachrichten*, No. 2910, an observation of Ceraski's made in 1884, as showing that it is not a mere effect of contrast with the shadow. M. Ceraski, on November 1, 1884, noticed a bright white spot on the ring where it touched the planet in a similar position to M. Terby's spot, but the shadow of the planet fell at that time on the other portion of the ring, so that the spot could not be accounted for by contrast.

COMET 1889 *c* (BARNARD, JUNE 23).—The following ephemeris for this object is by Dr. R. Spitaler (*Astr. Nach.* No. 2909):—

For Berlin Midnight.

1889.	R.A. h. m. s.	Decl. ° ′	Log Δ.	Brightness.
July 27	3 51 1	49 27·4 N.	0·1341	0·55
31	4 6 14	49 47·6	0·1416	0·50
Aug. 4	4 20 35	50 0·3	0·1486	0·46
8	4 34 0	50 7·0	0·1549	0·43
12	4 46 29	50 8·5	0·1606	0·40
16	4 58 1	50 6·0	0·1656	0·37
20	5 8 37	50 0·5 N.	0·1699	0·34

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 *JULY* 28—*AUGUST* 3.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 28

Sun rises, 4h. 20m.; souths, 12h. 6m. 14·0s.; daily decrease of southing, 1·3s.; sets, 19h. 53m.: right asc. on meridian, 8h. 31·6m.; decl. 18° 54′ N. Sidereal Time at Sunset, 16h. 20m.

Moon (New on July 28, 0h.) rises, 4h. 27m.; souths, 12h. 33m.; sets, 20h. 28m.: right asc. on meridian, 8h. 58·4m.; decl. 19° 51′ N.

Planet.	Rises. h. m.		Souths. h. m.		Sets. h. m.		Right asc. and declination on meridian. h. m.		° ′
Mercury..	3 13	...	11 19	...	19 25	...	7 44·6	...	22 4 N.
Venus ...	1 1	...	8 56	...	16 51	...	5 20·5	...	20 20 N.
Mars ...	3 10	...	11 18	...	19 26	...	7 43·1	...	22 20 N.
Jupiter ...	17 38	...	21 31	...	1 24*	...	17 58·1	...	23 22 S.
Saturn ...	5 46	...	13 11	...	20 36	...	9 36·7	...	15 27 N.
Uranus ...	11 12	...	16 42	...	22 12	...	13 8·6	...	6 38 S.
Neptune..	23 56*	..	7 45	...	15 34	...	4 9·8	...	19 23 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

July.		h.		
28	...	5	...	Mercury in conjunction with and 0° 14′ south of Mars.
28	...	20	...	Mercury at least distance from the Sun.
29	...	7	...	Saturn in conjunction with and 2° 16′ south of the Moon.

Variable Stars.

Star.	R.A. h. m.		Decl. ° ′			h. m.	
Algol	3 1·0	...	40 32 N.	...	Aug. 2,	1 50	*m*
R Ursæ Majoris ...	10 36·8	...	69 22 N.	...	,, 3,		*M*
W Virginis	13 20·3	...	2 48 S.	...	July 31,	22 0	*m*
X Boötis	14 19·0	...	16 50 N.	...	Aug. 2,		*M*
R Camelopardalis.	14 26·0	...	84 20 N.	...	July 31,		*M*
δ Libræ	14 55·1	...	8 5 S.	...	Aug. 1,	2 32	*m*
U Coronæ	15 13·7	...	32 3 N.	...	,, 3,	0 20	*m*
U Ophiuchi... ...	17 10·9	...	1 20 N.	...	July 28,	23 17	*m*
					Aug. 3,	0 2	*m*
X Sagittarii... ...	17 40·6	..	27 47 S.	...	July 28,	23 0	*M*
					Aug. 2,	3 0	*m*
U Sagittarii... ...	18 25·6	...	19 12 S.	...	July 29,	0 0	*M*
U Aquilæ	19 23·4	...	7 16 S.	...	,, 31,	22 0	*m*
η Aquilæ	19 46·8	...	0 43 N.	...	Aug. 3,	3 0	*M*
T Vulpeculæ ...	20 46·8	...	27 50 N.	...	July 31,	22 0	*M*
δ Cephei	22 25·1	...	57 51 N.	...	,, 30,	0 0	*M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.		Decl.		
Near δ Andromedæ ...	8°	...	32° N.	...	Swift; streaks.
,, δ Cassiopeiæ ...	20	...	58 N.	...	,, ,,
The *Perseids*	33	...	55 N.	...	,, ,,
The *Aquarids*	340	...	13 S.	...	Max. July 28.

GEOGRAPHICAL NOTES.

AN expedition is about to start for the exploration of Central Australia. Baron von Müller is interesting himself in the expedition, which will be under the command of the experienced explorer, Mr. Tietkens, who will also look specially after the botany and mineralogy. The point of departure will be Alice Springs, on the central telegraph line, and the country round Lake Amadeus will be carefully examined.

IT is reported from Brisbane, according to the *Colonies and India*, that the Queensland Government has concluded an agreement with Mr. A. Weston to lead an exploring party into the almost untrodden recesses of the northern portion of the colony, with a view to bringing to light scientific treasures supposed to be hidden there. Mr. Weston has accepted the undivided responsibility of leadership. Messrs. Broadbent and Bailey will be associated with him, and will respectively discharge the duties of collecting fauna and flora. The party will explore the region lying to the north-west of Cairns, including the Bellenden Ker Range and the shores of the volcanic lakes. It is also thought that something may be heard of Leichardt's expedition, traces of which are popularly supposed to be yet found in the back country. Mr. Weston has refused to accept any pecuniary assistance from the Government for his services.

M. A. DELCOMMUNE, who has been exploring several of the affluents of the Upper Congo, has arrived in Brussels. He has brought with him a valuable collection of African products, and some 200 views on the Upper Congo.

THE news that Dr. Macgregor, the Administrator of British New Guinea, has reached the summit of the Owen Stanley Range is of much interest. Since Captain Owen Stanley discovered the range, about forty-five years ago, various explorers have attempted to scale it, but all have failed. The summit reached by Dr. Macgregor is over 13,000 feet, and he reports several peaks almost equal in height. As Dr. Macgregor is a good botanist, his journey is likely to yield valuable scientific results.

DR. ALFRED HETTNER, in a communication to the *Verhandlungen* of the Berlin Geographical Society (No. 6, 1889), on his travels in Peru and Bolivia, gives the results of his observations on Lake Titicaca, which are of some interest. The surface of the lake, he states, has in the course of time been subject to great changes of level. The proof of these changes is to be found in the terraces around the lake. In a comparatively recent geological period, Dr. Hettner believes, the level of the lake must have been 20 metres higher than it is to-day, and the lake must have spread over the great part of the plain which now incloses it, perhaps as far as Lake Poopo. At a still earlier period the level of the lake must have been 200 metres above its present level, but between these stages, as many appearances indicate, the lake must have sunk below that level. The highest position of the lake-level is older than the glaciation of the district, and contemporaneous with a period of strong volcanic activity. The 20-metre high terraces may belong to the ice-period. For the idea of a former submersion below the sea Dr. Hettner can find no support; at the same time, he cannot altogether deny the possibility that at the time of the 200-metre terrace the lake may have had some connection with the ocean.

NITRATE OF SODA, AND THE NITRATE COUNTRY.[1]

II.

WE will now consider the structure of the actual nitrate beds. As before mentioned, there is no nitrate under the flat Pampa; but exactly where the first slopes of the coast range spring out of the plain, there nitrate is found at a small but variable distance below the surface. The width of the belt varies with the slope of the hill, being greatest where the slope is least, and the vertical height of the highest part of the bed appears to vary from 100 to 120 feet above the plain. It is, however, most important to notice that *the beds of nitrate follow the slope of the Pampa, and not a level line*. For instance, the northern extremity of the Pampa is some hundreds of feet higher than the southern portion, but the nitrate beds follow the spring of the hill from the plain, throughout their whole extent.

A very different sequence of beds lies under the slope of the hills from those alternating layers of mud, sand, and gravel which are found under the level Pampa. The surface covering of loose dust and small stones, extending to a depth of only a few inches, is locally known as *chuca* (see Fig. 3). This seems to be a native word, but I have been unable to ascertain its meaning. Below the *chuca* comes a very hard layer of earth and stones, almost compacted into rock, from 1 to 2 feet thick, which is called *costra* (Span. crust). Under this lies the *caliche*, or true nitrate deposit. This is a bed of from 1 to 3 feet thick, usually of a whitish crystalline structure, containing from 20 to 50 per cent. of nitrate of soda, with a residuum made up chiefly of common salt and earthy matter. *Caliche* is an Indian word, and may possibly come from the Aymara word *callachi*, a shell, or skull.

Passing through the *caliche*, a hard layer of stones and earth, compacted with salt crystals, is usually encountered. The Spanish workmen call this "*congelo*," because it is congealed or concreted by the salt.

After a foot or so of this, there comes finally a bed of soft, loose, *sweet* earth, containing a few very small loose stones, known as *cova*. I could not discover the signification of this word; but the whole method of working a nitrate bed turns round the properties of the *cova*.

A workman, with three or four chisel-pointed bars of iron, hence called a *barretero*, stands on the surface of the ground, and chips out a round hole, about a foot in diameter, down to the level of the *cova*. This hole is called a *tiro*, or charge for

[1] Continued from p. 188.

gunpowder (see Fig. 3). A small boy then scrambles down the hole, and easily excavates the soft *cova* a little under the *congelo*, forming an opening called the *taza*, or cup. The *taza* only is then filled with a slow-burning gunpowder, made of nitrate of soda on the premises, a tamping put into the *tiro*, and the charge exploded. The valuable *caliche* bed is thus simply lifted and partially broken, without being blown into dust; and a party of men separate the nitrate from the worthless beds, and carry it to the factory, or *maquina*.

Caliche varies so much in composition that it is almost impossible to give a typical analysis. One very rich specimen gave :—

	Per cent.
Nitrate of soda...	50
Chloride of sodium	26
Sulphate of soda...	6
,, magnesia	3
Insolubles	15
	100

but a more average sample might be taken to contain one-third nitrate; one-third salt; and one-third earth.

The problem for the manufacturer is to get the nitrate without the salt and earth; and the simple basis of the whole process rests on the fact that, while salt is rather more soluble in cold

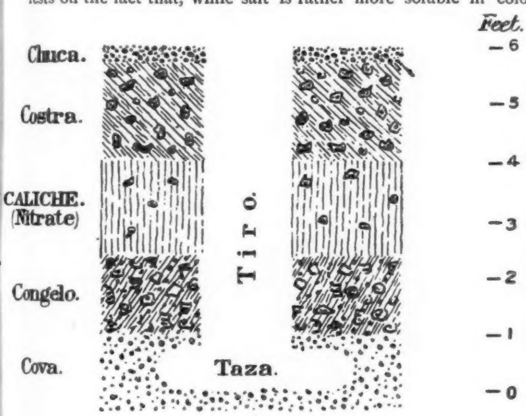


FIG. 3.

than in hot water, nitrate of soda is about four times more soluble in hot than cold water. It is also evident that, if a salty rock is washed with water already saturated with salt, no more of that material can be absorbed. The raw *caliche* is therefore first crushed into small pieces, washed with six changes of hot water, by what is known as the "passing system" similar to that used for lixiviating soda ash. After the last washing the waste *caliche* is known as *ripio* (refuse), and is thrown on to a rubbish heap; while the strongest hot water, which is drawn off the *caliche*, is known as *caldo*, or "broth."

The hot broth then runs for twenty minutes into a settling tank, where earth and salt are deposited, and after that into great square shallow *bateas*, or troughs. In about five days the greater part of the nitrate has been deposited nearly pure at the bottom of the *batea*, and a yellow orange liquid, known as *agua vieja*, remains on the top. This liquid is drawn off, the nitrate crystals drained, thrown on to a flat floor or *cancha*, to dry for three weeks, and then when bagged are ready for the market.

In many factories the *aqua vieja* is then pumped into the iodine room.

One sample of this fluid gave the following analysis :—

	Per cent.
Nitrate of soda...	28
Sulphate ,, ...	3
Chloride of sodium	11
Iodate ,, ...	22
Sulphate of magnesia	3
Water	33
	100

besides a small quantity of iodide of sodium, which cannot be utilized.

To separate the iodine a mixture of nitrate of soda and coal dust is formed into a pyramid and set alight, by which means a crude carbonate of soda is formed. Fumes of burning sulphur are then drawn through a solution of this carbonate, and an acid solution of sulphite of soda is produced. A suitable quantity of this last liquid is added to the *aqua vieja*, when iodine is precipitated in an impure form, which after sublimation becomes the iodine of commerce.

Nitrate of soda thus manufactured contains from 95 to 96 per cent. of pure nitrate, with less than 1½ per cent. of salt, the remainder being chiefly water. The nitrate is sold in Liverpool for about 10*s*. a hundredweight, while the iodine is disposed of in London for about 3*d*. an ounce.

It is impossible to examine a bed of crude nitrate of soda, without thinking how it got there. We have described the facts as to the position of some beds relative to the lie of the country, and also explained the character of the layers which adjoin the *caliche*, but unfortunately we can do little more. Numerous theories have of course been started, but none have either accounted for all the facts, or obtained general acceptance. This may perhaps be the case because no competent geologist has as yet thoroughly examined the nitrate beds in different parts of the country, but still a few remarks on the subject may be desirable. There is no doubt that the coast range and the Pampa have been elevated out of the sea at a comparatively recent period, but it is also equally certain that since that elevation the climate was at one time far more rainy than at present. All over the plains there are dry river-beds, and the flanks of the hills are scored by water-cut channels which could not have been carved out under the existing conditions of rainfall. This would make it doubtful whether the nitrate could have been deposited immediately after upheaval.

It may be noted as a curious fact that the stones found both in the *costra*, *caliche*, and *congelo* are usually angular; but in one nitrate ground I have certainly seen rounded pebbles in all these formations.

Much difficulty is always found in accounting for the existence of nitric acid. The existence in some deposits of a layer of guano under the *caliche* is a very suggestive fact, but unfortunately our knowledge of the circumstances is far too limited to allow of any generalizations on the subject. The presence of iodine in *caliche* has often been appealed to as pointing to the decomposition of beds of seaweed; but it may be remarked that there is a good deal of iodine about in the neighbouring mountains in the form of iodide of silver. We can only repeat the statement that the origin of nitrate of soda is at present unknown.

Whatever may have been the origin of the beds, there is no doubt that their existence is due to the rainlessness of the west coast of South America, so that a few remarks on the climate and weather of the *caliche* districts may be of interest. All along the coast we find three belts of climate and weather: that of the coast, that of the Pampa, and that of the Sierra.

Iquique may be taken as a typical station on the coast, and here fortunately a considerable amount of material has been accumulated through the labours of the Meteorological Commission for Chili. Speaking broadly, temperature at any season will rarely exceed 80°–85°, or fall below 50° at any hour in the coldest season; and as the air is always tolerably dry the climate is very bearable and wholesome. The wind blows from south to south-west throughout the year during the day, but at night sometimes comes more off the land from some point of east. Though nothing approaching to a gale ever blows at Iquique, the effect of distant storms is often experienced in the form of a heavy surf, which entirely stops any shipment of nitrate. The surf days, or *Bravesas* as they are called, occur most irregularly, for while in some years only nine days are recorded, other seasons have been credited with no less than forty-three days of enforced idleness. Contrary to the usual opinion, three or four slight but real showers fall every year, mostly in the months of June, July, and August, though this precipitation does not extend inland to the Pampa. The sky is usually clear, but a low stratus or strato-cumulus cloud often covers the sea and coast range during the forenoon, but dissipates as the sun gains power.

On the Pampa, where all the nitrate *oficinas* are built, the temperature may rise to 85° or 90° on the hottest days; and at night may fall to the freezing-point during the winter months. The air is much drier than on the coast; and though rain has been known to fall, it is certainly of very rare occurrence. Cloud is more rare on the Pampa than on the coast; but nearly every night a very thick wet fog settles over the plain. This is locally known as *camanchaca*, probably an Aymara word, whose

signification I have not been able to find out. The mist is popularly supposed to come from the sea, but this is only partly true. The fog doubtless rolls from the west or seaward side, but the origin is certainly due to local radiation, for the densest mist may lie over the Pampa, when there is no trace of fog on the sea-coast.

The nights and forenoons are usually calm on the Pampa, but about 1 p.m. a moderate wind springs up from the south-west, which falls away at sunset. During the night a light air sometimes blows from the Cordillera; and if the wind comes from the east, the *camanchaca* is immediately evaporated.

The Sierra or Cordillera is strangely enough governed by a totally different weather system from that of the coast; for it rains heavily in the mountains during the summer months of December, January, or February; and I have been assured that whenever it does rain on the Pampa, the precipitation has been blown over from the Sierra. *The extreme dryness of the Pampa is owing to its geographical position between the coast range, whose scanty rainfall occurs in winter, and the Sierra, where heavy rain falls in summer, but the precipitation of neither reaches the plain, which therefore remains a desert.* My own observations on the surface and upper winds along the whole length of the Andes, from Valparaiso to Lima, prove conclusively that the old theory that the dryness of the west coast of South America is due to the south-east trade rising over the Andes, and then descending as a warm dry current, is totally wrong, for I found all the winds over 10,000 feet, either from north-east or north-west.

The Pampa is very healthy, for fever is unknown, and though the heat and drought sometimes affect the liver, and a mild dysentery sometimes shows itself, still both are very amenable to proper treatment. There seems to be only one ailment special to the Pampa and the other nearly rainless districts of South America. This is the so-called "barley blindness" of mules and horses, which manifests itself by a white growth on the pupil of the eye. Absence of sufficient moist food is said to be the cause of this malady, and there is no doubt that if removed in time to a natural pasturage, the affected animal soon more or less recovers its sight.

RALPH ABERCROMBY.

FORTUITOUS VARIATION.

AT a meeting of the Biological Society of Washington (United States), held on December 15, 1888, Mr. Lester F. Ward read a paper on "Fortuitous Variation, as illustrated by the genus *Eupatorium*." He exhibited a series of specimens of that genus, mostly from the vicinity of Washington, and growing in great part in the same kind of soil and under the same general conditions. To simplify the question, the differences in the flowers, heads, and reproductive parts in general, which are less marked in this than in almost any other genus, were ignored, and attention was exclusively directed to the leaves. These, when closely compared, are seen to differ considerably in the different species, the forms ranging from the filiform dissected leaves of *E. fœniculaceum* to the broad ovate leaves of *E. ageratoides*. But between these extremes there are represented in the Washington flora numerous much more similar forms, which present to the observer a strongly marked family resemblance; from those with more elongate leaves, such as *E. altissimum*, *E. album*, and *E. teucrifolium*, through the increasingly broader more ovate forms, *E. perfoliatum*, *E. sessilifolium*, and *E. rotundifolium ovatum* (*E. pubescens*, Muhl.), with an intermediate undescribed form, which Dr. Gray regarded as a hybrid, connecting the last two to the typical *E. rotundifolium*, with its roundish, crenate, but still sessile leaves; and from this last form, with several similar Mexican species, on in the direction of acquiring a petiole, through several exotic forms, to *E. cœlestinum*, *E. aromaticum*, and *E. ageratoides*, in an almost unbroken chain of modifications without any apparent advantage to the plants. Almost any other genus might have served the purpose of the paper, but this one seemed to possess the merit of simplicity.

The question naturally arises, in looking at such a group of clearly related forms, all of which, on the modern view, must surely have descended from some common ancestral stock, Why have they varied at all? Why need there be more than one species of Eupatorium in the same restricted flora? Or, if some can be shown to have probably varied in order to adapt themselves to different local conditions, why need there be more than one form occurring under precisely the same conditions? Variation caused by natural selection can only occur where some advantage is secured through it, whereby the new form becomes, by ever so little, better fitted to survive under the conditions of its existence. But here there seems to be no such advantage. It is easy to say that we are incapable of detecting the subtle influences that make one form surer of existence than another. The staunch believer in natural selection may be satisfied with such an explanation, but is it not too much to ask of the new convert or the sceptic? Is not the spread of the doctrine hindered rather than helped by such a demand? Moreover, it was shown that several different forms actually flourish together in the very same localities, and that this is not exceptional, but the common case, so that the idea of special fitness of form to station is precluded. And is it not antecedently improbable that there should be any advantage in a plant's having a sharp-pointed rather than a blunt-pointed leaf, a serrate rather than a crenate one, or a sessile rather than a short-petioled one? Science becomes metaphysics when such questions are discussed.

The speaker proposed to escape from the dilemma by denying that advantage, or fitness to survive, or natural selection, had anything to do with such variations; and he maintained that they were truly fortuitous in the only true sense of that term. By this he did not mean to say that they were due to mere chance in the sense of being without cause; and the remainder of his paper was devoted to an attempt to explain the cause of fortuitous variation. It may be briefly summed up as follows:—

Organized or living matter constantly tends to increase in quantity, which may be regarded as the true end of organic being, to which the perfection of structure, commonly mistaken for such end, is only one of the means. Every organic element may be contemplated as occupying the centre of a sphere, toward the periphery of which, in all directions alike, it seeks to expand, and would expand but for physical obstructions which present themselves. The forms which have succeeded in surviving are those, and only those, that were possible under existing conditions; that is, they have been developed along the lines of least resistance, pressure along all other lines having resulted in failure. Now, the various forms of vegetable and animal life represent the latest expression of this law, the many possible, and the only possible, results of this universal *nisus* of organic being. The different forms of *Eupatorium*, or of any other plant or animal, that are found co-existing under identical conditions merely show that there were many lines along which the resistance was not sufficient to prevent development. They are the successes of Nature.

Mr. Ward disclaimed any desire to discredit or impair in any way the great law of natural selection. The most important variations, those which lead up to higher types of structure, are the result of that law, which therefore really explains organic evolution; but the comprehension and acceptance of both natural selection and evolution are retarded instead of being advanced by claiming for the former more than it can explain, and it might as well be recognized first as last that a great part—numerically, by far the greater part—of the variety and multiplicity, as well as the interest and charm, of Nature is due to another and quite distinct law, which, with the above qualifications, may perhaps be appropriately called "the law of fortuitous variation."

SCIENTIFIC SERIALS.

American Journal of Science, July.—A new Erian (Devonian) plant allied to Cordaites, by Sir William Dawson. This unique specimen from the lower Catskill (Upper Devonian), Wyoming County, Pennsylvania, presents the peculiarity of combining the fructification of the Cordaiteæ with foliage akin to that of Næggerathia, thus connecting two Palæozoic groups which are now considered as allied to Cyadeæ and Taxineæ.—The law of thermal relation, by William Ferrel. The object of these researches is to compare Dulong and Petit's older formulæ and the more recent determination of Stefan with the principal available data derived from experiment and observation, with a view to ascertaining what modifications these formulæ may require in order accurately to represent the true law of relation between the intensity of the radiation and the temperature of a body. It appears generally that neither of the formulæ in question represents the true law of Nature through the whole range of experiments, but that different values are required for different ranges of temperature. To determine the true mean value with greater accuracy experiments upon radiation will have to be made at much lower temperatures than any yet made.—Stratigraphic position of the Olenellus fauna in North America and Europe (continued), by Charles D. Walcott. Since writing the first part

of this article the author has completed the survey of all the species known to him from the Olenellus (Lower Cambrian) zone in North America. From a general comparison of this zone with the Ordovician the superiority of the latter in number of species, genera, and families becomes at once apparent. But when the comparison is extended to class characters, the disparity is much reduced, and it is made evident that the evolution of life between the two epochs has been in the direction of differentiating the class types that existed in the earlier fauna. It cannot be asserted that the Olenellus fauna of Europe and North America was contemporaneous, although its relations to the succeeding Middle and Upper Cambrian and Ordovician is everywhere essentially the same, the Olenellus being the basal fauna wherever it has been found.—On allotropic forms of silver (continued), by M. Carey Lea. The properties are given of the two already described insoluble forms of allotropic silver, which differ from normal silver especially in their sensitiveness to light, their brittleness and specific gravities (9·58 and 8·51, the normal being 10·5).—The peridotite of Pike County, Arkansas: Part I., description and general relations, by John C. Branner; Part II., microscopic study, by Richard N. Brackett. Though small in extent, the exposure of peridotite occurring near Murfreesboro, Pike County, is geologically important, as offering a clue to the time and character of the disturbing influences which about the close of the Cretaceous sank the greater part of Arkansas and other contiguous regions beneath the ocean. It is also interesting as being the third reported occurrence of picrite-porphyry in the United States. Its position and topographic features are shown in the accompanying map.—Papers are contributed by T. M. Chatard, on urao, shown to be the true natural form of sodium carbonate; by Edward F. Ayres, on the crystallization of trona (urao), from Borax Lake, California; by G. F. Kunz, on fluorite, amber, opal, and diamond; and by O. C. Marsh, on the discovery of Cretaceous Mammalia by J. B. Hatcher in the Laramie formation of Dakota and Wyoming. There is also a reprint of Mr. James Croll's paper in the Quarterly Journal of the London Geological Society for May 1889, on prevailing misconceptions regarding the evidence of former glacial periods.

IN the *American Meteorological Journal* for June, Mr. A. L. Rotch contributes an interesting article on the organization of the meteorological service in Belgium. The Royal Observatory was established in 1826, and deals with astronomy, meteorology, and magnetism. The present net-work of stations consists of three Observatories (including Liége, which is independent of the Royal Observatory), fifty stations of the second order, and about 120 rain-stations. Instruments are generally lent, but the observers are volunteers. The most notable instrument in use is the electrical meteorograph, invented by F. van Rysselberghe, which engraves its indications on metal plates, from which copies can be printed. The recording apparatus can work at any distance from the meteorological instruments.—Lieutenant J. P. Finley gives a chronological table of tornadoes in the State of Michigan for sixty-six years ending 1888, with a chart. The total number of storms observed was seventy-six; the year of greatest frequency, 1886—eighteen storms. The greatest monthly frequency was in May and September, and the prevailing direction of movement, north-east. The publication of these statistics is the more valuable, as we learn from another part of the *Journal* that recent restrictions on the publications of the Chief Signal Office prevent it from issuing Lieutenant Finley's tornado charts.—Prof. F. Waldo has a review on some important tornado literature. The author points out where the most important discussions of the subject can be found, and calls attention to some particular points therein. Most of the authentic accounts between 1835–50 are contained in *Silliman's Journal*, since which time most prominent meteorologists have investigated the subject, especially Loomis and Reye.—Mr. W. W. Harrington contributes an article on the whirlpool theory of storms. The object of the paper is to lay before the readers of the *Journal* the views of M. Faye, as formulated in his work, "Les Tempêtes" (1887), which work was reviewed in our columns. Mr. Harrington offers no opinion upon the theory itself, or upon the criticisms of the same.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 15.—M. Hermite in the chair.—Observations of the small planets and of Barnard's comet made at the great meridian instrument of the Paris Observatory during the second half of the year 1888, by M. Mouchez.—Thermic researches on the isomeric nitric camphors and on cyanic camphor, by MM. Berthelot and P. Petit. From these researches it appears that, between Cazeneuve's two isomerous nitric camphors, answering to the formula $C_{20}H_{15}NO_6$, there exists the same difference as between a nitrified body and a nitric ether, or any substance of analogous function; further, that nitro-phenol camphor must be less explosive than the corresponding isomerous body. For cyanic camphor the mean heat of combustion has been determined at 8445·3 calories.—On the decomposition of the sulpho-conjugated acids by means of phosphoric acid, by MM. C. Friedel and J. M. Crafts. On recently resuming their study of this question the authors have found that owing to the secondary reactions the decomposition of the acids in question in presence of sulphuric acid does not usually yield all the hydrocarburets contained in them. But the complete decomposition may be effected by mixing the sodium or potassium salt of a sulphonic acid with a considerable excess of concentrated phosphoric acid at a temperature of 60° Baumé.—On the studies in atmospheric micrography undertaken at the Imperial Observatory of Rio de Janeiro, by M. L. Cruls. Considerable interest attaches to these researches, made in a tropical region and in the immediate vicinity of a large city frequently visited by epidemics. Some of the atmospheric particles, obtained in the usual way, have been photographed M. Morize, of the Rio Observatory, and enlarged by 150, 500, and 1000 diameters. In order to collect sufficient data for comparative purposes, M. Cruls has been authorized by the Brazilian Government to organize a special laboratory to carry out a systematic series of microscopic studies on the site that has been chosen for the construction of a branch of the Rio Observatory.—Observations of Barnard's comet (June 23, 1889) made at the Observatory of Algiers with the 0·50 metre telescope, by MM. Trépied and Sy, on July 1 and 5.—On the Brownian movement, by M. Gouy. The author has studied this phenomenon under a great variety of conditions and with diverse kinds of liquids and particles. It results from his observations that this movement is produced with particles of every description, its intensity diminishing in direct ratio to the viscosity of the fluid and the size of the particles; also that it is a perfectly regular phenomenon, produced at a constant temperature and independently of all external influences. Thousands of particles have been examined, and in no single case has any particle in suspension failed to present the usual movement, with its normal intensity regularly decreasing with the increased size, but not with different kinds of particles, the solid, liquid, and gaseous all behaving much alike under like conditions. This fact clearly shows that the cause of the phenomenon is to be sought, not in the bodies themselves, but in the fluid element, whose internal movement they serve to render visible. Hence the Brownian movement alone of all physical phenomena reveals to the eye a constant state of internal agitation in bodies independently of all outward influences. The fact here established will naturally be associated with current kinetic hypotheses, and may perhaps be regarded as a faint and remote result of calorific molecular movements. In this phenomenon the velocities may be estimated at some microns per second, or about 1/100,000,000 of those attributed to molecular movement.—On the electrolysis of distilled water, by M. E. Duter. These experiments, and especially that conducted with aluminium, point to the inference that there are formed at the negative pole metallic hydrides, which are destroyed by the water with formation of an oxide and liberation of hydrogen.—On the ammonio-cobaltic molybdates, tungstates, and vanadates; separation of cobalt and nickel, and of the cobaltous and cobaltic salts, by Adolphe Carnot. The ammonio-cobaltic salts differ in many respects from the corresponding salts of the cobalt and nickel protoxides. But their respective characters are not, as a rule, sufficiently marked to serve to discriminate and separate these salts. M. Carnot, however, now finds that this advantage is presented by the molybdates, tungstates, and vanadates. In the present paper he deals with the molybdates alone.—On the reactions of oils with nitrate of silver, by M. Raoul Brullé. During his researches on the character of different oils, the author has been led to employ the nitrate of silver as a reagent. The results present remarkable differences in the case of olive, cotton, linseed, colza, and other vegetable oils.—On the egg of the sardine, by M. Georges Pouchet. The author's observations show that the sardine *de rogue* (the small sardine of commerce) is a young fish not yet arrived at maturity, and presenting the greatest irregularity in the development both of the ovaries and the ovules; nor, as a rule, is the size any clue to its state of development.

VIENNA.

Imperial Academy of Sciences, May 9.—The following papers were read:—On the preparation of indol from phenylglycocoll, by J. Mauthner and W. Suida.—On amides of carbonic acid (second communication), by F. Emich.—On the knowledge of some non-drying oils, by K. Hazura and A. Gruessner.—On the transplantation of bone, by A. Adamkiewicz.—On nerve-corpuscles in their physiological and pathological state, by the same.—Experiments on the decomposition of albumen by anaërobous micro-organisms, and on the aromatic products of decomposition, by the same.—Contribution to the knowledge of gases developed by the fermentation of albumen, by M. Nencki and N. Sieber.—On the formation of para-lactic acid by the fermentation of sugar, by the same.—On benzoyl-compounds of alcohols, phenols, and sugars, by Zd. H. Skraup.—On the constitution of grape-sugar, by the same.—Experimental researches on the periodic law, Part 1, by B. Brauner.—Researches on musical psychology and acoustics, by K. Stecker.—Preparatory studies for a monograph on *Muscaria schizometopa*; Part 1, synopsis of genera, by F. Brauer and J. von Bergenstamm.—On the crystals of grape-sugar and optically-active substances in general, by F. Becke.—On new improvements of the usual process of combustion, by F. Blau.—Note on the preparation of mono- and dibromo-pyridin, by the same.—On dry distillation of picolinate of copper, by the same.—On a new test for albuminous bodies, by C. Reichel.—Monograph on the fossorial wasps allied with Nysson and Bembex, by A. Handlirsch.—Embryological researches on Ascomycetes, by H. Zukal.

AMSTERDAM.

Royal Academy of Sciences, June 29.—Prof. v. d. Waals, Vice-President, in the chair.—M. Franchimont stated that, as early as the beginning of this year, he prepared the pentamethylene glycol, its oxide, and an unsaturated alcohol of five C-atoms, by boiling pentamethylene dinitramine with diluted sulphuric acid, as also the bromide agreeing with the glycol; and that M. Dekkers had treated the tetramethylene-dinitramine in the same manner. The properties of the pentamethylene glycol agree with those published a few days ago by M. Gustavson, who obtained this compound by another method. He spoke further of the action of nitric acid on carbonic and nitrogenic compounds, and of the influence exercised upon them by certain atomic groups. As instances of carbonic compounds he cited malonic acid esters and their derivatives; of nitrogenic compounds, all kinds of amides, urethanes, &c., so that the extraordinary strong influence of the group $COOCH_3$ appears most clearly, even in the derivatives of piperidine.—M. Pekelharing treated of the destruction of the virus of anthrax in the subcutaneous tissues of rabbits. Small pieces of gelose with a culture of anthrax bacilli, whether containing spores or not, packed in parchment-paper, introduced under the skin in rabbits, not only do not superinduce anthrax in the inoculated animals, but are themselves deprived of virulence. This is the case even when the wound remains perfectly aseptic, of course without application of any antiseptic matter. Leucocytes penetrate into the packets, but the bacilli or spores are not materially affected thereby. Therefore, next to the phagocytose, whose existence is nowise denied, the action of a dissolved substance for the destruction of bacilli must be taken into account.—M. de Vries read a paper on the spiral torsion in wild teasel (*Dipsacus sylvestris*). In opposition to the prevalent opinion, which regards the cases of spiral torsion (called by Alex. Braun *Zwangsdrehung*) as accidents, the speaker deemed himself justified in regarding this phenomenon as an hereditary variation; and this in consequence of an experiment begun by him in 1885 with two twisted individuals. From the seed of the same about 1650 plants were reared in 1887, among which were again two twisted specimens. The seed of these gave in 1889 above 1500 plants, among which were found a little more than 4 per cent. of twisted individuals. The torsion is, therefore, not only hereditary, but will gradually become fixed by the customary method of artificial selection. From the 4 per cent. twisted specimens the best have been selected for seed-bearers further to improve the race.—M. van Bemmelen mentioned the results obtained by M. Bakhuÿs Roozeboom in the pursuit of his researches concerning the behaviour of salts with regard to water. The normal course of the solubility may be disturbed by the appearance of a second layer of fluid when the salt and water are not mixed in all proportions. Mr. Bakhuÿs Roozeboom succeeded in illustrating the peculiarities of the behaviour in such cases in two examples: $AsBr_3$, and a salt recently detected by M. van Romburgh—

$$C_6H . NO_2 . N\genfrac{}{}{0pt}{}{CH_3}{NO_2} . OK.$$

BOOKS, PAMPHLETS, and SERIALS RECEIVED

Names and Synonyms of British Plants; G. Egerton-Warburton (Bell).—Swiss Travel and Swiss Guide Books: W. A. B. Coolidge (Longmans).—The Human Foot: T. S. Ellis (Churchill).—The Railways of England: W. M. Acworth (Murray).—Farm Live-Stock of Great Britain: R. Wallace (Edinburgh, Oliver and Boyd).—La Lutte pour l'Existence: L. Frederico (Paris, Baillière).—Modern Views of Electricity: O. J. Lodge (Macmillan).—Traité Pratique de la Thermométrie de Précision; C. E. Guillaume (Paris, Gauthier-Villars).—An Elementary Class-book of General Geography: H. R. Mill (Macmillan).—The Micro-organisms of Fermentation practically considered: A. Jörgensen; edited from the German by G. H. Morris (Lyon).—Useful Rules and Tables, 7th edition: by W. J. M. Rankine; revised by W. J. Millar, with Electrical Engineering Tables, &c., by A. Jamieson (Griffin).—Dianthus: F. N. Williams (West).—Psycho-Physiologische Protisten-Studien: Dr. Max Verworn (Jena, Fischer).—Œuvres Complètes de Christian Huygens, tome deuxième (La Haye, M. Nijhoff).—British Rainfall, 1888: G. J. Symons (Stanford).—Solutions of the Examples in Higher Algebra: H. S. Hall and S. R. Knight (Macmillan).—Timber and Some of its Diseases: H. M. Ward (Macmillan).—Index of Spectra, revised edition: W. M. Watts (Manchester, A. Heywood).—Journal and Proceedings of the Royal Society of New South Wales, vol. xxii. Part 2 (Trübner).—Journal of the Royal Statistical Society, June (Stanford).

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